CHAPTER 73

LIST OF EFFECTIVE TEMPORARY REVISIONS

FOLLOWING IS A COMPLETE LISTING OF ALL ACTIVE TEMPORARY REVISIONS (TR'S). TR'S NOT LISTED SHOULD BE REMOVED. THE ATA NUMBER, CONFIG CODE AND PAGE NUMBER IDENTIFIES THE PAGE PRECEDING THE TR.

TR NUMBER	ATA NUMBER	CONFIG CODE	PAGE NUMBER	TR DATE

NONE

CHAPTER 73

ENGINE FUEL AND CONTROL

LIST OF EFFECTIVE PAGES

CHAPTER/ SECTION	PAGE	DATE	CONFIG CODE
List of Effective Pages	1	Jun 15/96	
	2	Jun 15/96	
	3	Jun 15/96	
	4	Jun 15/96	
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	6	Jun 15/96	
Table of Contents	1	Nov 15/86	
	2	Nov 15/86	
	3	Mar 15/91	
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73-conts	1	Nov 15/89	
73-conts	2	Nov 15/86	
73-conts	3	Nov 15/86	
73-conts	4	Nov 15/86	
73-conts	5/6	Dec 15/94	
73-DIAGM	1	May 15/90	
73-DIAGM	2	Jul 15/83	
73-DIAGM	3/4	Feb 15/82	
73-INDEX	1	Nov 15/88	
73-INDEX	2	Nov 15/88	
73-INDEX	3/4	Nov 15/88	
73-00-00	1	May 15/87	
73-00-00	2	May 15/87	
73-00-00	3	May 15/87	
73-00-00	4	May 15/85	
73-00-00	5	May 15/85	
73-00-00	6	May 15/87	
73-00-00	7/8	May 15/87	
73-00-00	101	Nov 15/89	
73-00-00	102	Nov 15/86	
73-00-00	103	Nov 15/81	
73-00-00	104	Nov 15/89	
73-00-00	105	Nov 15/86	
73-00-00	106	Nov 15/89	
73-00-00	107	Nov 15/89	
73-00-00	108	Nov 15/86	
73-00-00	109/110	Nov 15/89	
73-00-00	111/112	Nov 15/89	
73-00-00	113/114	Nov 15/86	
73-00-00	115/116	Nov 15/86	
73-00-00	117/118	Nov 15/86	
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73-00-00	121/122	Nov 15/86	
73-00-00	123/124	Nov 15/86	
73-00-00	125/126	Nov 15/86	
73-00-00	127/128	Nov 15/86	
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73-00-00	131/132	Nov 15/86	
73-00-00	133/134	Nov 15/86	
73-00-00	135/136	Nov 15/86	
73-00-00	201	Jul 15/84	
73-00-00	202	Jul 15/84	
73-00-00	203	Jul 15/84	
73-00-00	204	Jul 15/84	
73-00-00	205	Jul 15/84	
73-00-00	206	Jul 15/84	
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73-00-00	208	Jul 15/84	
73-00-00	209/210	Jul 15/84	
73-00-00	301	Nov 15/88	
73-00-00	302	Nov 15/88	
73-00-00	303	Nov 15/88	
73-00-00	304	Nov 15/85	
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73-00-00	306	Nov 15/88	
R 73-00-00	307	Jun 15/96	
73-00-00	308	Jun 15/95	
73-00-00	309	Nov 15/88	
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73-00-00	311	Jun 15/95	
73-00-00	312	Dec 15/94	
73-00-00	313	Dec 15/94	
73-00-00	314	Dec 15/94	
R 73-00-00	315/316	Jun 15/96	
73-00-00	501/502	May 15/77	
73-00-00	601	Nov 15/88	
73-00-00	602	Nov 15/88	
73-00-00	603/604	Nov 15/88	

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73-11-00	2	May 15/87	
73-11-00	3	May 15/87	
73-11-00	4	May 15/87	
73-11-00	5	May 15/87	
73-11-00	6	May 15/87	
73-11-00	7	May 15/87	
73-11-00	8	May 15/87	
73-11-00	9	May 15/87	
73-11-00	10	May 15/87	
73-11-00	11	May 15/87	
73-11-00	12	May 15/87	
73-11-00	13/14	May 15/87	
73-11-00	15/16	May 15/87	
73-11-01	401	Mar 15/91	
73-11-01	402	Mar 15/91	
73-11-01	403	Mar 15/91	
73-11-01	404	Mar 15/91	
73-11-01	405	Mar 15/91	
73-11-01	406	Mar 15/91	
73-11-01	407	Mar 15/91	
73-11-01	408	Mar 15/91	
73-11-01	409	Mar 15/91	
73-11-01	410	Mar 15/91	
73-11-01	411	Jun 15/95	
73-11-01	412	Jun 15/95	
73-11-01	413	Mar 15/91	
73-11-01	414	Mar 15/91	
73-11-01	415	Mar 15/91	
73-11-01	416	Mar 15/91	
73-11-01	417	Mar 15/91	
73-11-01	418	Mar 15/91	
73-11-01	501	Nov 15/89	
73-11-01	502	Nov 15/89	
73-11-01	503	Feb 15/82	
73-11-01	504	Nov 15/89	
73-11-01	505	Mar 15/81	
73-11-01	506	Nov 15/89	
73-11-01	507	Nov 15/89	
73-11-01	508	Dec 15/91	
73-11-01	509/510	Dec 15/91	
73-11-01	601	Mar 15/91	
73-11-01	602	Mar 15/91	
73-11-01	603/604	Mar 15/91	
73-11-02	201	Nov 15/88	
73-11-02	202	Nov 15/88	
73-11-02	203/204	Nov 15/88	
73-11-03	201/202	May 15/77	
73-11-04	401	Nov 15/85	
73-11-04	402	Nov 15/85	
73-11-04	403	Mar 15/84	
73-11-04	404	Nov 15/87	
73-11-04	405	Nov 15/88	
73-11-04	406	Nov 15/87	
73-11-04	407/408	Nov 15/88	
73-11-04	501/502	Mar 15/84	
73-11-05	401	May 15/90	
73-11-05	402	May 15/90	
73-11-05	403	May 15/85	
73-11-05	404	May 15/85	
73-11-05	405	May 15/85	
73-11-05	406	May 15/90	
73-11-05	407	May 15/90	
73-11-05	408	May 15/90	
73-11-05	409	May 15/85	
73-11-05	410	May 15/90	
73-11-05	411	May 15/90	
73-11-05	412	May 15/90	
73-11-05	601/602	May 15/85	
73-11-06	201	Nov 15/83	
73-11-06	202	Nov 15/83	
73-11-06	401	May 15/90	
73-11-06	402	May 15/90	
73-11-06	403	May 15/90	
73-11-06	404	May 15/90	
73-11-06	405	May 15/90	
73-11-06	406	May 15/90	
73-11-06	407	May 15/90	
73-11-06	408	May 15/90	
73-11-06	409	May 15/90	
73-11-06	410	May 15/90	
73-11-06	411	May 15/90	
73-11-06	412	May 15/90	
73-11-06	413	May 15/90	
73-11-06	414	May 15/90	
73-11-06	415	May 15/90	
73-11-06	416	May 15/90	
73-11-06	417	May 15/90	
73-11-06	418	May 15/90	
73-11-06	419	May 15/90	
73-11-06	420	May 15/90	
73-11-06	421	May 15/90	
73-11-06	422	May 15/90	
73-11-06	423	May 15/90	
73-11-06	424	May 15/90	
73-11-06	425	May 15/90	

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73-11-06	427	May 15/90	
73-11-06	428	May 15/90	
73-11-06	429	May 15/90	
73-11-06	430	May 15/90	
73-11-06	431	May 15/90	
73-11-06	432	May 15/90	
73-11-06	433/434	May 15/90	
73-11-06	435	May 15/90	
73-11-06	436	May 15/90	
73-11-06	601	May 15/90	
73-11-06	602	May 15/90	
73-11-06	603	May 15/90	
73-11-06	604	May 15/90	
73-11-06	605	May 15/90	
73-11-06	606	May 15/90	
73-11-06	607	May 15/82	
73-11-06	608	May 15/90	
73-11-06	609/610	May 15/90	
73-11-08	401	Mar 15/80	
73-11-08	402	May 15/77	
73-11-08	403	Mar 15/80	
73-11-08	404	Mar 15/80	
73-11-08	405	Mar 15/80	
73-11-08	406	Feb 15/79	
73-11-08	407	Mar 15/80	
73-11-08	408	May 15/77	
73-11-08	501	Aug 15/82	
73-11-08	502	Aug 15/82	
73-11-08	503	Aug 15/82	
73-11-08	504	Aug 15/82	
73-11-08	505	Aug 15/82	
73-11-08	506	Aug 15/82	
73-11-09	401	May 15/86	
73-11-09	402	May 15/86	
73-11-09	403	May 15/85	
73-11-09	404	May 15/86	
73-11-09	405	May 15/86	
73-11-09	406	May 15/86	
73-11-09	407	May 15/85	
73-11-09	408	Jun 15/94	
73-11-09	409	May 15/86	
73-11-09	410	May 15/85	
73-11-09	411	May 15/86	
73-11-09	412	May 15/86	
73-11-09	413	May 15/85	
73-11-09	414	May 15/85	
73-11-09	415	May 15/86	
73-11-09	416	May 15/86	
73-11-09	417	Jun 15/94	
73-11-09	418	May 15/86	
73-11-09	419/420	Jun 15/94	
73-11-09	601	May 15/85	
73-11-09	602	May 15/85	
73-11-09	701	May 15/85	
73-11-09	702	May 15/85	
73-11-10	201	Mar 15/91	
73-11-10	202	Nov 15/88	
73-11-10	203	Jun 15/95	
73-11-10	204	Jun 15/95	
73-11-10	205	Mar 15/91	
73-11-10	206	Jun 15/95	
73-21-00	1	Nov 15/87	
73-21-00	2	Nov 15/87	
73-21-00	3	Nov 15/89	
73-21-00	4	Aug 15/82	
73-21-00	5	Nov 15/86	
73-21-00	6	Nov 15/86	
73-21-00	7	Nov 15/87	
73-21-00	8	Nov 15/87	
73-21-00	9	Nov 15/87	
73-21-00	10	Nov 15/87	
73-21-00	11	Nov 15/87	
73-21-00	12	Nov 15/87	
73-21-00	13	Nov 15/87	
73-21-00	14	Nov 15/87	
73-21-00	15	Nov 15/87	
73-21-00	16	Nov 15/87	
73-21-00	17	Nov 15/87	
73-21-00	18	Nov 15/87	
73-21-00	19	Nov 15/87	
73-21-00	20	Nov 15/87	
73-21-00	21	Nov 15/87	
73-21-00	22	Nov 15/87	
73-21-00	23	Nov 15/87	
73-21-00	24	Nov 15/87	
73-21-00	25	Nov 15/87	
73-21-00	26	Nov 15/87	
73-21-00	27	Nov 15/87	
73-21-00	28	Nov 15/87	
73-21-00	29	Nov 15/87	
73-21-00	30	Nov 15/87	
73-21-00	31	Nov 15/87	
73-21-00	32	Nov 15/87	
73-21-00	33	Nov 15/87	
73-21-00	34	Nov 15/87	

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73-21-00	38	Nov 15/87	
73-21-00	39/40	Nov 15/87	
73-21-00	41/42	Nov 15/87	
73-21-00	43	Nov 15/87	
73-21-00	44	Nov 15/87	
73-21-00	45	Nov 15/87	
73-21-00	46	Nov 15/87	
73-21-00	47/48	Nov 15/87	
73-21-00	49/50	Nov 15/87	
73-21-00	51/52	Nov 15/87	
73-21-00	53/54	Nov 15/87	
73-21-00	55/56	Nov 15/87	
73-21-00	57/58	Nov 15/87	
73-21-00	59/60	Nov 15/87	
73-21-00	61/62	Nov 15/87	
73-21-00	63/64	Nov 15/87	
73-21-00	65/66	Nov 15/87	
73-21-00	67/68	Nov 15/87	
73-21-00	69/70	Nov 15/87	
73-21-00	71/72	Nov 15/87	
73-21-00	201	May 15/88	
73-21-00	202	May 15/88	
73-21-00	501	Nov 15/86	1
73-21-00	502	Nov 15/86	1
73-21-00	503	Nov 15/87	1
73-21-00	504	May 15/89	1
73-21-00	505	May 15/89	1
73-21-00	506	May 15/89	1
73-21-00	507	May 15/89	1
73-21-00	508	May 15/89	1
73-21-00	509	Nov 15/85	1
73-21-00	510	May 15/87	1
73-21-00	511	Nov 15/85	1
73-21-00	512	Nov 15/85	1
73-21-00	513	Nov 15/86	1
73-21-00	514	Nov 15/87	1
73-21-00	515	Nov 15/85	1
73-21-00	516	May 15/86	1
73-21-00	517	Nov 15/86	1
73-21-00	518	Nov 15/86	1
73-21-00	519	Nov 15/85	1
73-21-00	520	Nov 15/85	1
73-21-00	521/522	May 15/89	1
73-21-00	501	Nov 15/86	2
73-21-00	502	Nov 15/87	2

CHAPTER/ SECTION	PAGE	DATE	CONFIG CODE
73-21-00	503	Nov 15/86	2
73-21-00	504	May 15/89	2
73-21-00	505	May 15/89	2
73-21-00	506	Nov 15/86	2
73-21-00	507	Nov 15/86	2
73-21-00	508	May 15/87	2
73-21-00	509	Nov 15/86	2
73-21-00	510	Nov 15/86	2
73-21-00	511	Nov 15/86	2
73-21-00	512	Nov 15/87	2
73-21-00	513	Nov 15/86	2
73-21-00	514	Nov 15/86	2
73-21-00	515	Nov 15/86	2
73-21-00	516	Nov 15/86	2
73-21-00	517	Nov 15/86	2
73-21-00	518	Nov 15/86	2
73-21-01	201	May 15/88	
73-21-01	202	Nov 15/88	
73-21-01	203	Dec 15/91	
73-21-01	204	Aug 15/82	
73-21-01	205	Dec 15/91	
73-21-01	206	Dec 15/91	
73-21-01	207	Dec 15/91	
73-21-01	208	Dec 15/91	
73-21-01	209	Aug 15/82	
73-21-01	210	Dec 15/91	
73-21-01	211	Dec 15/91	
73-21-01	212	Dec 15/91	
73-21-01	213	Dec 15/91	
73-21-01	214	Dec 15/91	
73-21-01	215	May 15/90	
73-21-01	216	Dec 15/91	
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73-21-01	219/220	Aug 15/82	
73-21-01	221	Dec 15/91	
73-21-01	222	Dec 15/91	
73-21-01	223	Dec 15/91	
73-21-01	224	Dec 15/91	
73-21-01	225	Dec 15/91	
73-21-01	226	Dec 15/91	
73-21-01	227	Dec 15/91	
73-21-01	228	Dec 15/91	
73-21-01	229	Dec 15/91	
73-21-01	230	Dec 15/91	
73-21-01	231	Dec 15/91	
73-21-01	232	Dec 15/91	
73-21-01	233	Dec 15/91	
73-21-01	234	Dec 15/91	

CHAPTER/ SECTION	PAGE	DATE	CONFIG CODE
73-21-01	235	Dec 15/91	
73-21-01	236	Dec 15/91	
73-21-01	237	Dec 15/91	
73-21-01	238	Dec 15/91	
73-21-01	239	Dec 15/91	
73-21-01	240	Dec 15/91	
73-21-01	241	Dec 15/91	
73-21-01	242	Dec 15/91	
73-21-01	243	Dec 15/91	
73-21-01	244	Dec 15/91	
73-21-02	401	May 15/86	
73-21-02	402	May 15/86	
73-21-02	403	May 15/86	
73-21-02	404	May 15/86	
73-21-02	405	May 15/86	
73-21-02	406	May 15/86	
73-21-03	201	May 15/89	
73-21-03	202	May 15/89	
73-21-03	203	May 15/88	
73-21-03	204	Mar 15/80	
73-21-03	205	Mar 15/80	
73-21-03	206	May 15/88	
73-21-03	207	May 15/88	
73-21-03	208	May 15/88	
73-21-03	209	May 15/88	
73-21-03	210	May 15/88	
73-21-03	211	Mar 15/80	
73-21-03	212	May 15/88	
73-21-03	213	May 15/88	
73-21-03	214	May 15/88	
73-21-03	215	May 15/88	
73-21-03	216	May 15/88	
73-21-03	217	May 15/88	
73-21-03	218	May 15/88	
73-21-03	219	May 15/88	
73-21-03	220	May 15/88	
73-21-03	221	May 15/88	
73-21-03	222	May 15/88	
73-21-04	401	Nov 15/83	
73-21-04	402	Nov 15/83	
73-21-04	403/404	Nov 15/83	
73-21-04	601	Nov 15/81	
73-21-04	602	Nov 15/81	
73-21-05	201	Nov 15/89	
73-21-05	202	Nov 15/89	
73-21-05	203	May 15/89	
73-21-05	204	Nov 15/89	
73-21-07	201/202	May 15/77	
73-21-07	501/502	May 15/88	
73-21-13	201	May 15/77	
73-21-13	202	May 15/77	
73-21-13	203/204	May 15/77	
73-21-16	401	May 15/82	
73-21-16	402	May 15/82	
73-21-16	403/404	May 15/82	
73-21-21	201	May 15/82	
73-21-21	202	May 15/82	
73-21-21	203	May 15/82	
73-21-21	204	May 15/82	
73-21-21	205/206	Aug 15/82	
73-30-00	1/2	May 15/77	
73-30-00	3/4	May 15/77	
73-31-00	1	May 15/77	
73-31-00	2	May 15/77	
73-31-00	3/4	Nov 15/82	
73-31-00	5/6	May 15/77	
73-31-00	101	Mar 15/81	
73-31-00	102	Mar 15/81	
73-31-00	103	Mar 15/81	
73-31-00	104	Mar 15/81	
73-31-00	105	Aug 15/82	
73-31-00	106	Jun 15/95	
73-31-00	107/108	Nov 15/82	
73-31-00	201	May 15/88	
73-31-00	202	May 15/88	
73-31-00	501/502	May 15/77	
73-31-01	401	Jun 15/80	
73-31-01	402	Dec 15/93	
73-31-01	403	Dec 15/93	
73-31-01	404	Dec 15/93	
73-31-01	405/406	Dec 15/93	
73-31-02	401	May 15/77	
73-31-02	402	Dec 15/93	
73-31-02	403	Dec 15/93	
73-31-02	404	Dec 15/93	
73-31-02	405/406	Dec 15/93	
73-34-00	1	May 15/77	
73-34-00	2	Feb 15/82	
73-34-00	3/4	Feb 15/82	
73-34-00	5	May 15/77	
73-34-00	6	May 15/77	
73-34-00	7	May 15/77	
73-34-00	8	May 15/77	
73-34-00	9	May 15/77	
73-34-00	10	May 15/77	
73-34-00	11	May 15/77	

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73-34-00	12	May 15/77	
73-34-00	101	Mar 15/81	
73-34-00	102	Mar 15/81	
73-34-00	103	Mar 15/81	
73-34-00	104	May 15/82	
73-34-00	105/106	May 15/82	
73-34-00	501	May 15/86	
73-34-00	502	May 15/77	
73-34-01	401	Nov 15/81	
73-34-01	402	Nov 15/81	
73-34-01	403	Nov 15/81	
73-34-01	404	Nov 15/81	
73-34-01	405/406	Nov 15/81	
73-34-03	401	May 15/77	
73-34-03	402	May 15/77	
73-34-04	401	May 15/77	
73-34-04	402	May 15/77	
73-34-04	403/404	May 15/77	
73-37-00	1	May 15/77	
73-37-00	2	May 15/77	
73-37-00	3	May 15/77	
73-37-00	4	May 15/77	
73-37-00	5	May 15/77	
73-37-00	6	May 15/77	
73-37-00	101	Mar 15/81	
73-37-00	102	Mar 15/81	
73-37-00	103	Mar 15/81	
73-37-00	104	Mar 15/81	
73-37-00	105/106	Aug 15/81	
73-37-00	501	May 15/77	
73-37-00	502	May 15/77	
73-37-01	401	Jun 15/80	
73-37-01	402	Jun 15/80	
73-37-01	403/404	Jul 15/83	
73-37-02	401	May 15/77	
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73-37-04	402	May 15/77	
73-37-04	403/404	May 15/77	
73-38-00	1	May 15/86	
73-38-00	2	May 15/86	
73-38-00	3	May 15/86	
73-38-00	4	May 15/86	
73-38-00	5/6	May 15/86	
73-38-01	401	May 15/86	
73-38-01	402	May 15/86	
73-38-01	403	May 15/86	
73-38-01	404	May 15/86	
73-38-02	401	May 15/86	
73-38-02	402	May 15/86	
73-38-02	403	May 15/86	
73-38-02	404	May 15/86	
73-38-02	405	May 15/86	
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73-38-02	407/408	May 15/86	

CHAPTER 73

ENGINE FUEL AND CONTROL

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STARTING	7100
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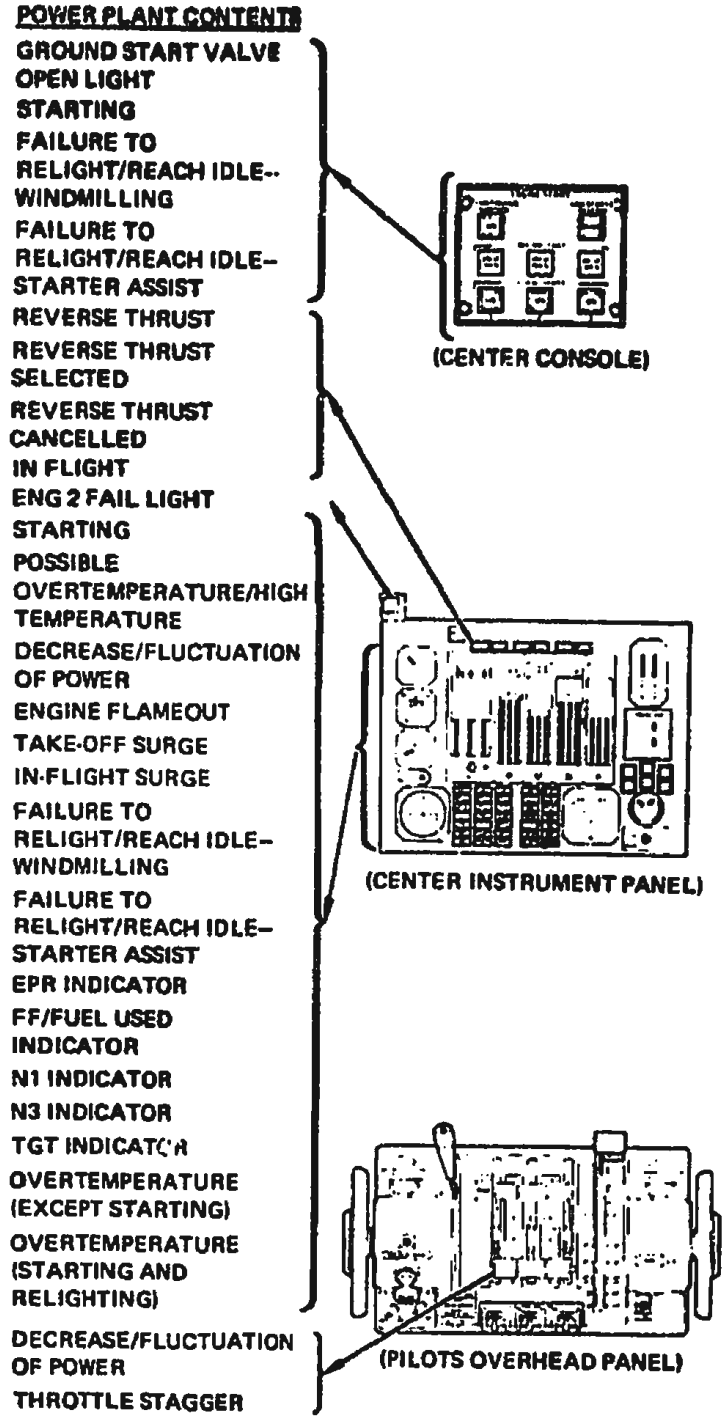

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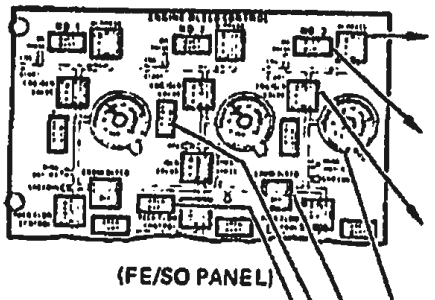
ENGINE FUEL AND CONTROL CONTENTS

R EFFECTIVITY: ALL
R
001B



(FE/SO PANEL)

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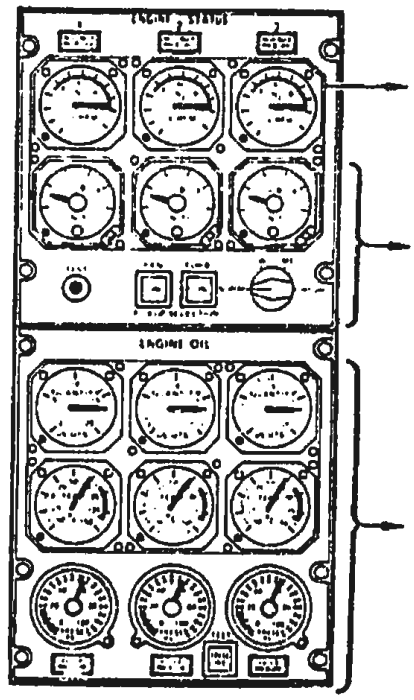
CROSSBLEED START
ENGINE BLEED AIR
NACELLE/PYLON
OVERHEAT DETECTION

DUCT OVHT, ENGINE
(1, 2, OR 3)

GROUND START VALVE
OPEN LIGHT
ENGINE BLEED AIR

CROSSBLEED START
POSSIBLE
OVERTEMPERATURE/HIGH
TEMPERATURE
ENGINE BLEED AIR

CROSSBLEED START
AREA OVHT, BLEED AIR
(J)
AREA OVERHEAT TEST
AREA OVHT, BLEED AIR
(D, E, OR H)



(FE/SO PANEL)

STARTING

AIRBORNE VIBRATION
MONITOR
N2 OVERSPEED
N2 INDICATOR

ABNORMAL OIL SYSTEM
INDICATIONS
RISE IN FUEL/OIL
TEMPERATURE
STARTING
OIL PRESSURE LOW/HIGH
OIL FILTER PRESSURE
LIGHT
ENGINE FLAMEOUT

TITLE	CHAP/SEC
ABNORMAL OIL SYSTEM INDICATIONS	7900
AIRBORNE VIBRATION MONITOR	7731
AREA OVERHEAT TEST	3600
AREA OVHT, BLEED AIR (D, E, OR H)	3600
AREA OVHT, BLEED AIR (J)	3600
CROSSBLEED START	3600
DUCT OVHT, ENGINE (1, 2, OR 3)	3600
ENGINE BLEED AIR	3600
ENGINE FLAMEOUT	7100
GROUND START VALVE OPEN LIGHT	8011
NACELLE/PYLON OVERHEAT DETECTION	2600
N2 INDICATOR	7712
N2 OVERSPEED	7100
OIL FILTER PRESSURE LIGHT	7900
OIL PRESSURE LOW/HIGH	7900
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RISE IN FUEL/OIL TEMPERATURE	7337
STARTING	7100

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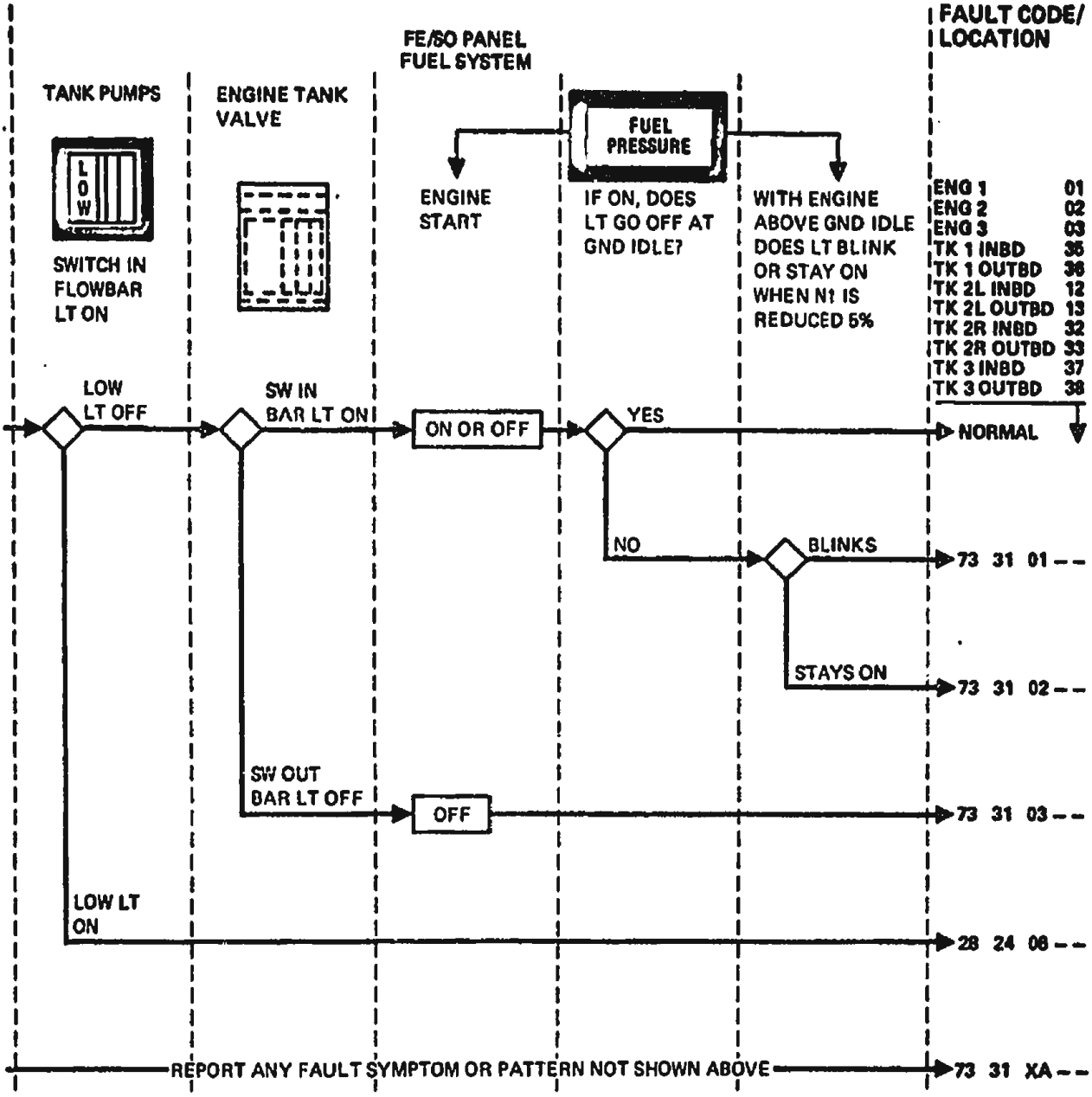
R ENGINE FUEL AND CONTROL CONTENTS

EFFECTIVITY: ALL

001B


FAULT CODE/ LOCATION
FE/SO PANEL FUEL SYSTEM
TANK PUMPS
ENGINE TANK VALVE
FUEL PRESSURE
L O W
SWITCH IN FLOWBAR LT ON
ENGINE START
IF ON, DOES LT GO OFF AT GND IDLE?
WITH ENGINE ABOVE GND IDLE DOES LT BLINK OR STAY ON WHEN N1 IS REDUCED 5%
ENG 1 01
ENG 2 02
ENG 3 03
TK 1 INBD 35
TK 1 OUTBD 36
TK 2L INBD 12
TK 2L OUTBD 13
TK 2R INBD 32
TK 2R OUTBD 33
TK 3 INBD 37
TK 3 OUTBD 38
LOW LT OFF
SW IN BAR LT ON
ON OR OFF
YES
NORMAL
NO
BLINKS
73 31 01 - -
STAYS ON
73 31 02 - -
SW OUT BAR LT OFF
OFF
73 31 03 - -
LOW LT ON
28 24 08 - -
REPORT ANY FAULT SYMPTOM OR PATTERN NOT SHOWN ABOVE
73 31 XA - -
APPLICABLE CIRCUIT BREAKERS
3P4, 10, 16 FUEL LOW PRESSURE
3T6, 9, 12 ENG TANK VALVE
3U1 OR 3U2 INBD PUMP IND
3U3, 3U4 OR 3U5, 3U6 OUTBD BOOST PUMP
3U7-3U10 INBD BOOST PUMP
3U13, 3U14 OUTBD BOOST PUMP
3U15 OUTBD PUMP IND

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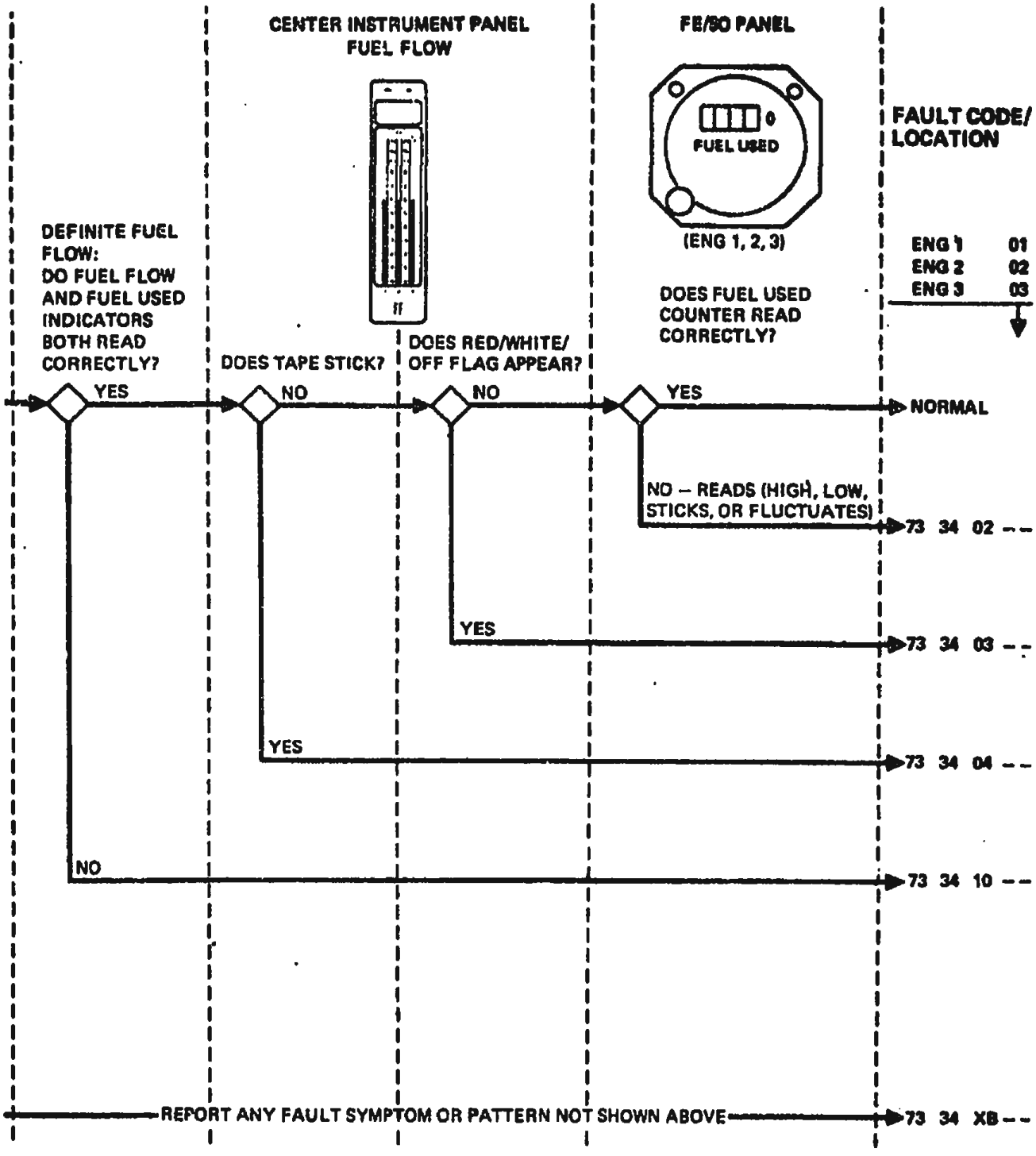
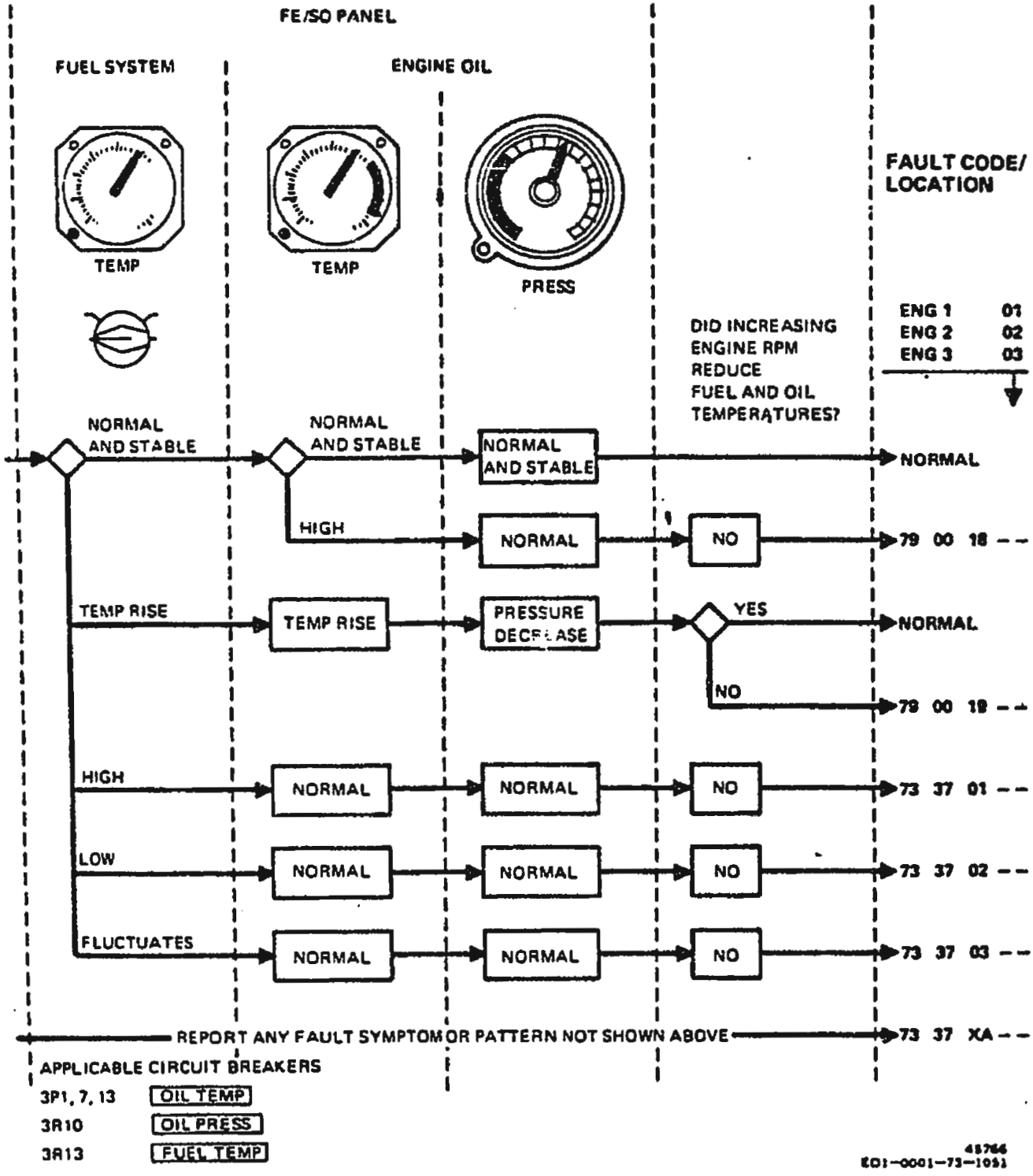
R Fuel Pressure Light - Fault Codes
Figure 1



R FUEL FLOW/FUEL USED Indicator - Fault Codes
Figure 2



R Fuel/Oil Temp - Fault Codes
Figure 3

R EFFECTIVITY: ALL

73-FAULT CODE DIAGRAM

FAULT CODE INDEX
TABLE 1

FAULT CODE	1. LOG BOOK REPORT 2. FAULT ISOLATION REFERENCE
73 31 XA __	1. A Fuel Pressure Light fault was encountered by the crew which is not covered in the fault code diagram. (Ref. Chapter 28 for Fault Code diagram.) 2. 73-31-00 Fig. 103 Block 1
73 34 XB __	1. A FUEL FLOW/FUEL USED Indicator fault was encountered by the crew which is not covered in the fault code diagram. (Ref. Fault Code diagram for flight crew actions.) 2. 73-34-00 Fig. 103 Block 1
73 37 XA __	1. A Fuel/Oil Temp fault was encountered by the crew which is not covered in the fault code diagram. (Ref. Fault Code diagram for flight crew actions.) 2. 73-37-00 Fig. 103 Block 1 79-00-00 Fig. 109 Block 1
73 31 01 __	1. (01=ENG 1, 02=ENG 2, 03=ENG 3) FUEL PRESSURE light on with engine above ground idle, light blinked when N1 was decreased 5 percent; tank valve and pump switch latched, flowbars on, PUMP LOW lights off. 2. 73-31-00 Fig. 103 (Sheet 2) Block 4
73 31 02 __	1. (01=ENG 1, 02=ENG 2, 03=ENG 3) FUEL PRESSURE light on with engine above ground idle; did not go off when N1 reduced 5 percent; tank valve and pump switches latched, PUMP LOW lights off. (Ref. Chapter 28 for Fault Code diagram.) 2. 73-31-00 Fig. 103 (Sheet 2) Block 2

FAULT CODE INDEX
TABLE 1 (CONTINUED)

FAULT CODE	1. LOG BOOK REPORT 2. FAULT ISOLATION REFERENCE
73 31 03 __	1. (01=ENG 1, 02=ENG 2, 03=ENG 3) FUEL PRESSURE light off with tank valve closed (tank valve switch unlatched, flowbar off). (Ref. Chapter 28 for Fault Code diagram.) 2. 73-31-00 Fig. 103 (Sheet 1) Block 3
73 34 01 00	1. NOT USED.
73 34 02 __	1. (01=ENG 1, 02=ENG 2, 03=ENG 3) FUEL USED counter reads incorrectly (high, low, sticks or fluctuates). 2. 73-34-00 Fig. 103 Block 2
73 34 03 __	1. (01=ENG 1, 02=ENG 2, 03=ENG 3) FF RED-WHITE-OFF flag appears. 2. 73-34-00 Fig. 103 Block 11
73 34 04 __	1. (01=ENG 1, 02=ENG 2, 03=ENG 3) FF tape sticks. 2. 73-34-00 Fig. 103 Block 18
73 34 05 00	1. NOT USED.
73 34 06 00	1. NOT USED.
73 34 07 00	1. NOT USED.
73 34 08 __	1. (01=ENG 1, 02=ENG 2, 03=ENG 3) FUEL USED does not confirm fuel quantity. FUEL quantity correct. 2. 73-34-00 Fig. 103 Block 1
73 34 09 00	1. NOT USED.
73 34 10 __	1. (01=ENG 1, 02=ENG 2, 03=ENG 3) FUEL FLOW and FUEL USED INDICATORS BOTH READ INCORRECTLY. 2. 73-34-00 Fig. 103 Block 9

FAULT CODE INDEX
TABLE 1

FAULT CODE	1. LOG BOOK REPORT 2. FAULT ISOLATION REFERENCE
73 37 01 __	1. (01=ENG 1, 02=ENG 2, 03=ENG 3) fuel temp high. Oil temp and press normal. 2. 73-37-00 Fig. 103 Block 1
73 37 02 __	1. (01=ENG 1, 02=ENG 2, 03=ENG 3) fuel temp low. Oil temp and press normal. 2. 73-37-00 Fig. 103 Block 1
73 37 03 __	1. (01=ENG 1, 02=ENG 2, 03=ENG 3) fuel temp fluctuates. Oil temp and press normal. 2. 73-37-00 Fig. 103 Block 1

ENGINE FUEL AND CONTROL - DESCRIPTION AND OPERATION

1. General

The engine fuel system (zones 412, 422 and 432) automatically delivers fuel to the combustion system at a flow rate consistent with the engine power requirement set by the flight station throttle lever (zone 210). It then maintains the set power irrespective of ambient temperatures up to a specific I.S.A. limit during climb, cruise and take-off. Above these temperatures it may be necessary to restrict engine
R power to prevent limiting values of shaft speed or shaft speed and T.G.T. being exceeded.

The system, illustrated diagramatically in fig.1, is divided into a number of sub-systems which are listed below and further described in the sections shown.

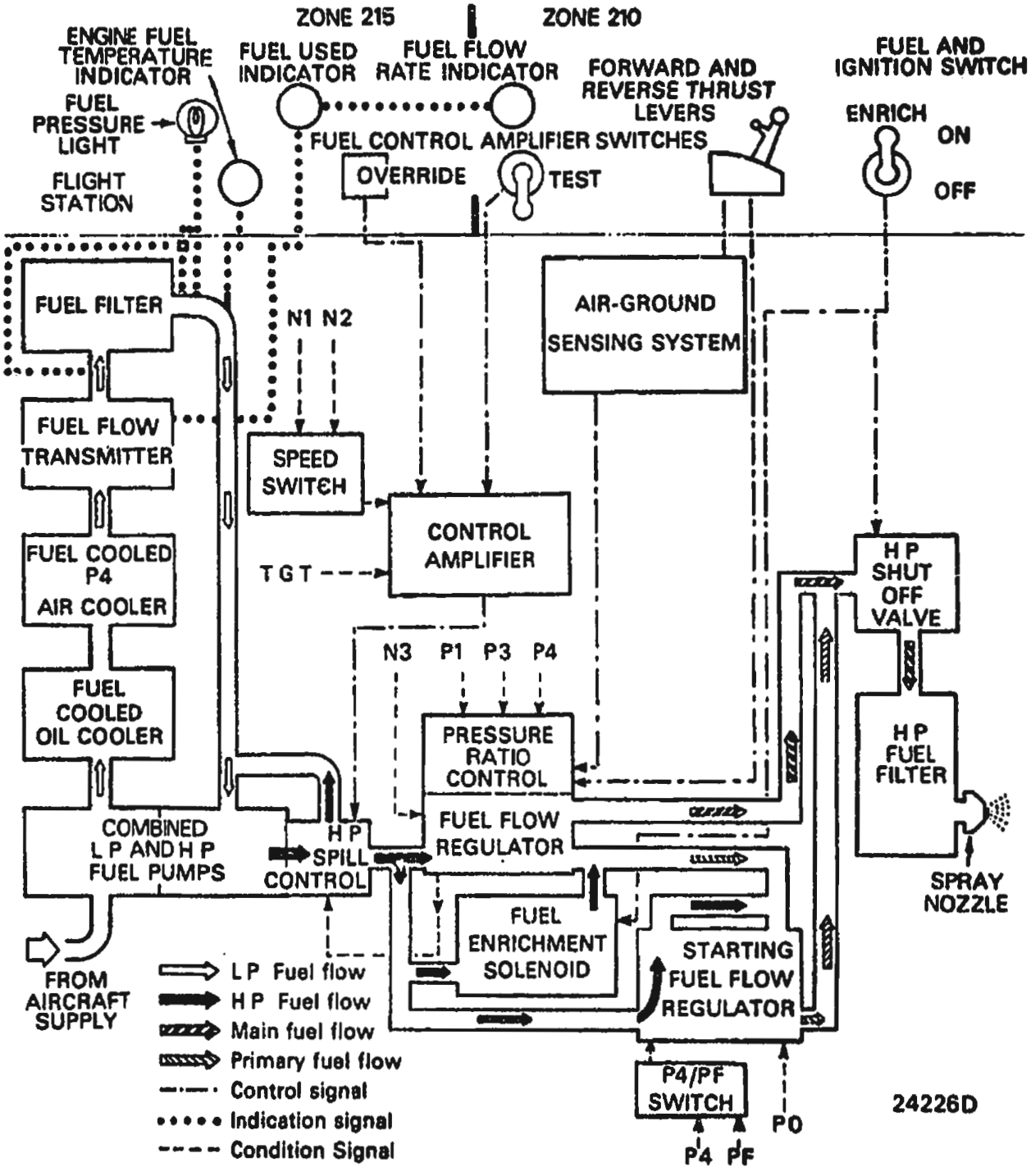
73-11-00 - Fuel supply system
73-21-00 - Fuel control system
73-31-00 - Engine fuel pressure system
73-34-00 - Fuel flow/consumed system
73-37-00 - Fuel temperature system
73-38-00 - Fuel indicating AIDS

2. Description

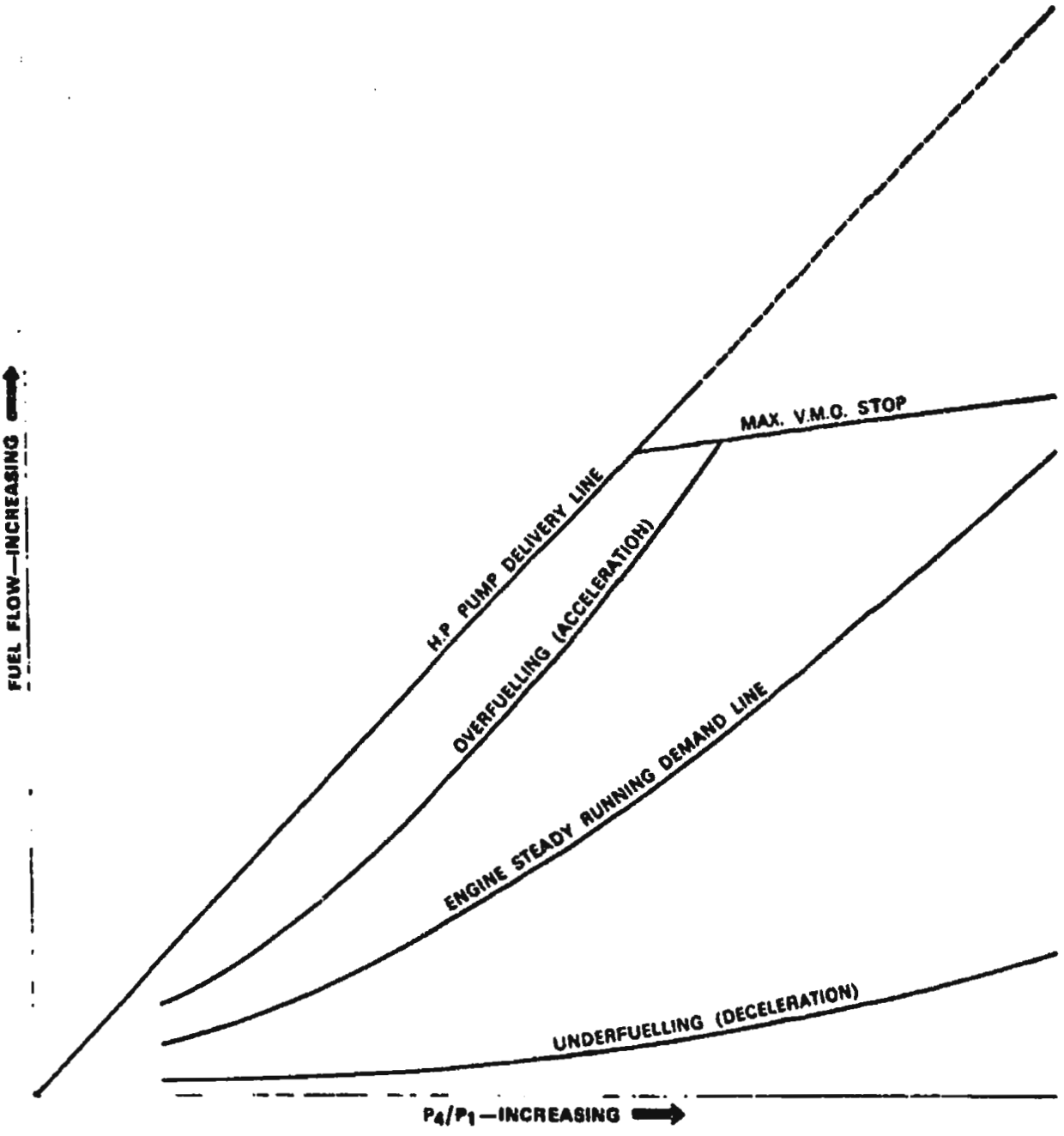
A. Fuel Supply System

Fuel from the aircraft supply system is delivered by the L.P. fuel pump through a fuel cooled oil cooler, fuel cooled P4 air cooler, fuel flow transmitter and fuel filter to the H.P. fuel pump. The H.P. pump delivers the fuel through a fuel flow regulator, starting fuel
R flow regulator, H.P. shut-off valve H.P. fuel filter and a fuel manifold to eighteen spray nozzles located in the combustion section.

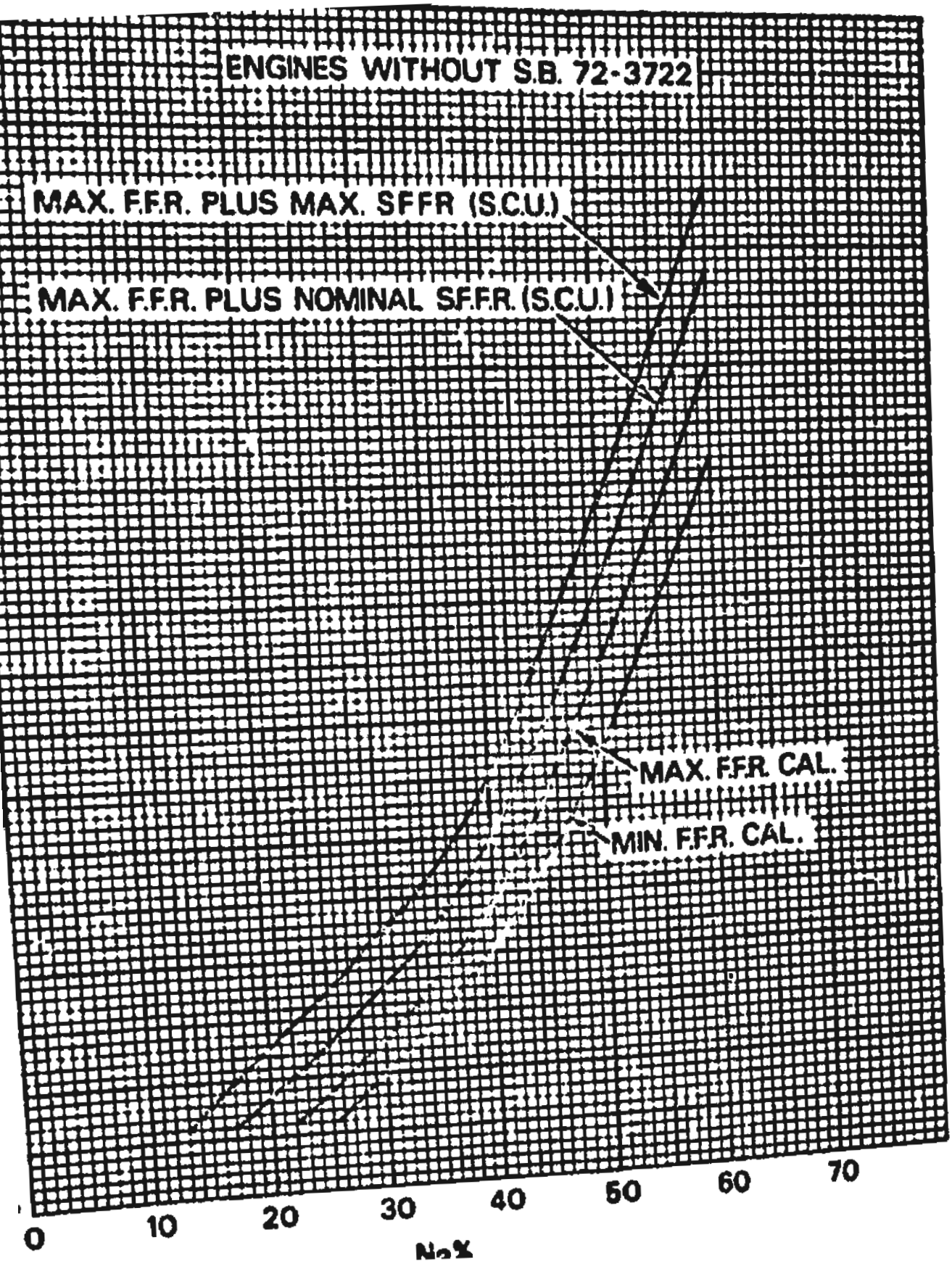
Manual control of fuel flow for engine starting and stopping is effected through a 3-position fuel and ignition switch (zone 210) that controls the power supply to the electrically actuated H.P. shut-off valve and a fuel enrichment solenoid.

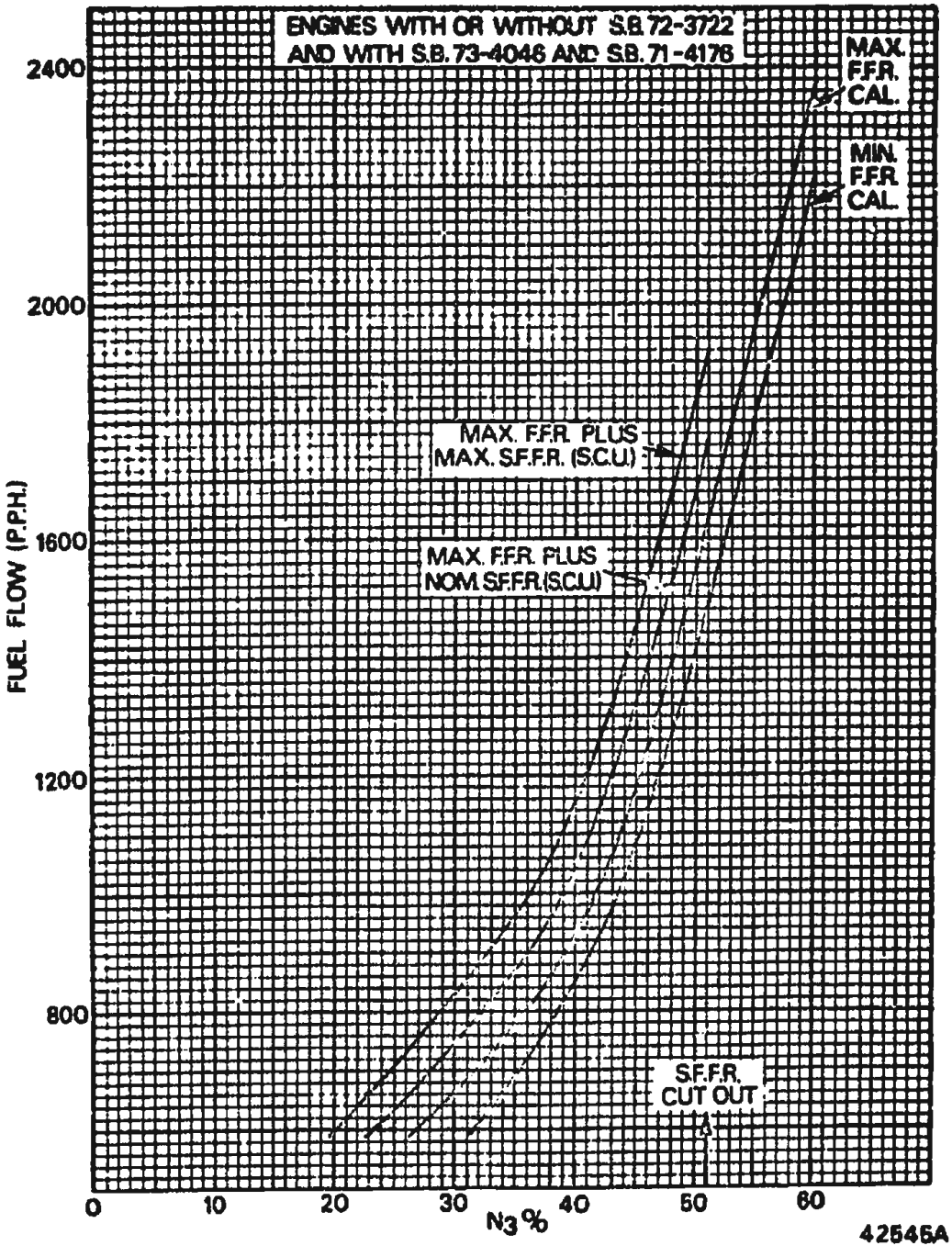


R Fuel system simplified diagram
R Fig.1



Fuel flow characteristics
Fig.2


ENGINES WITHOUT S.B. 72-3722
MAX. F.F.R. PLUS MAX. SFFR (S.C.U.)
MAX. F.F.R. PLUS NOMINAL SF.F.R. (S.C.U.)
MAX. F.F.R. CAL.
MIN. F.F.R. CAL.
0
10
20
30
40
50
60
70
NoX



R Typical starting fuel flows guide - engine with or without
R S.B.72-3722 and with S.B.73-4046 and S.B.72-4176
R Fig.3 (Sheet 2)

EFFECTIVITY: ALL

B. Engine Fuel Control System

Primary fuel flow during engine starting is controlled by the starting fuel flow regulator. The starting regulator also controls an H.P. fuel supply that by-passes the fuel flow regulator and enriches the primary flow for the duration of the starting cycle. The enrichment supply passes through a solenoid operated valve incorporated in the starting regulator, that is energized by the starting system and de-energize by the P4/PF switch.

To assist engine starting an additional enrichment fuel supply can be selected from the flight station. This supply is tapped from the starting fuel flow regulator H.P. fuel supply and passed through the fuel enrichment solenoid into the primary fuel supply to the starting fuel flow regulator. The solenoid is energized when the fuel and ignition switch is selected to the ENRICH position.

Fuel scheduling, at idle and above, is effected automatically by the fuel flow regulator in response to the power requirement selected by the flight station throttle lever. The fuel flow regulator uses the ratio of H.P. compressor delivery pressure to air intake pressure (P4/P1) as the main controlling parameter. In addition to P4 and P1, the fuel flow regulator senses H.P. compressor inlet pressure (P3) and H.P. shaft speed (N3). The combined effect of these signals is to position two metering devices in the fuel flow regulator to schedule fuel flow consistent with the power selected. The fuel pressure drop created by the metering devices is transmitted to the H.P. pump spill control, which spills delivery flow in excess of engine requirement back to the H.P. pump inlet. As illustrated in the trend graph (Ref. fig.2) the amount of H.P. delivery fuel spilled is varied to provide the necessary over and underfuelling schedules required during acceleration and deceleration.

The fuel flow regulator also facilitates the automatic selection of a reduced idle power (ground idle) for taxiing and ground holding, and incorporates stops that limit the maximum and minimum fuel flow.

R An electronic amplifier, which senses signals of shaft speed or shaft speed and T.G.T., is incorporated in the control system. If maximum limitations are reached by either of these parameters the amplifier reduces fuel flow to the spray nozzles by disturbing the pressure drop signals sensed by the spill control to increase H.P. fuel spillage. When the over limitation condition is alleviated control of H.P. fuel spill is returned to the fuel flow regulator.

C. Engine Fuel Pressure System

The fuel pressure system consists of two pressure switches, located on the fuel filter, that provide signals to a low fuel pressure and filter differential pressure indicator at the flight station (zone 215).

D. Fuel Flow/Consumed System

The fuel flow transmitter, located between the P4 fuel cooled air cooler and the fuel filter, provides signals for flight station indication of fuel flow rate (zone 210) and fuel used (zone 215).

E. Fuel Temperature System

A fuel temperature bulb located at the fuel filter outlet provides signals for a common engine fuel temperature indicator at the flight station (zone 215).

F. Fuel Indicating AIDS

Fuel system signals to the aircraft integrated data system (AIDS) are provided by a high pressure fuel differential pressure transducer and a throttle angle position transducer. The differential pressure transducer senses the fuel pressure drop across the fuel flow regulator, and the throttle angle transducer senses the air throttle lever position through movement of the fuel flow regulator control box output lever (Ref. 76-11-00).

3. Operation

The operation of the fuel system sub-systems and their associated units are described in the Chapter/Sections stated in 1. General.

FUEL AND CONTROL - FAULT ISOLATION

1. General

The diagrams and schematics in this section can be used for fault isolation any time a fault is reported or suspected. Uncommon abbreviations are defined on the using fault code diagram or schematic.

If the flight crew reports a trouble using a fault code number, the code number can be found in the Fault Isolation Reference Table in the Chapter 71 Fault Code Index. The index specifies the exact maintenance manual section, fault isolation diagram, and block number on the diagram where the fault isolation procedure should start. Where applicable, schematics are included at the end of the section to supplement the fault code diagrams or as an aid in isolating a problem not covered on the diagrams.

Refer to the Maintenance Manual Introduction for a more detailed discussion of the Fault Isolation Reporting Method (FIRM) and use of fault isolation diagrams/schematics.

2. Fault Isolation/Identification

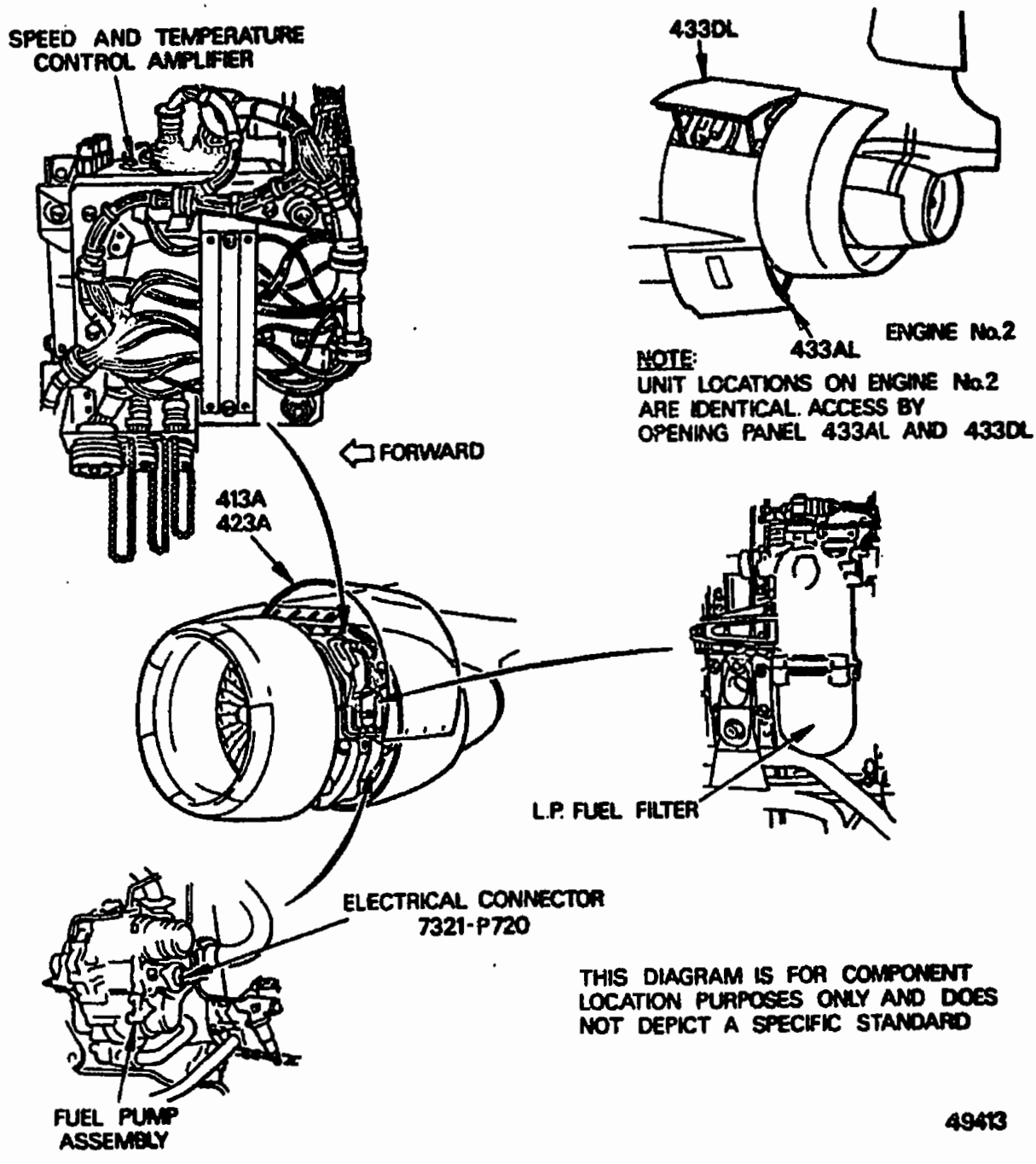
Table 101 lists the fault isolation diagrams and schematics in this section.

TABLE 101

FIGURE	TITLE
Fig.102	Component locator diagram
Fig.103	Low fuel pressure warning light 'ON' (with or without low power indications).
Fig.104	Redatum system/variable restrictor inoperative.
Fig.105	Fuel and control - Controlling
Fig.106	Fuel and control - Controlling (engine)
Fig.107	Engine control schematic

COMPONENT	QTY	ACCESS/AREA	REFERENCE
FILTER - L.P. FUEL			
PUMP - COMBINED	3	ENGINE: 413A, 423A, 433AL	73-11-01
L.P. AND H.P. FUEL	3	ENGINE: 413A, 423A, 433AL	73-11-01
AMPLIFIER - SPEED AND TEMPERATURE CONTROL	3	ENGINE: 413A, 423A, 433AL	73-21-02

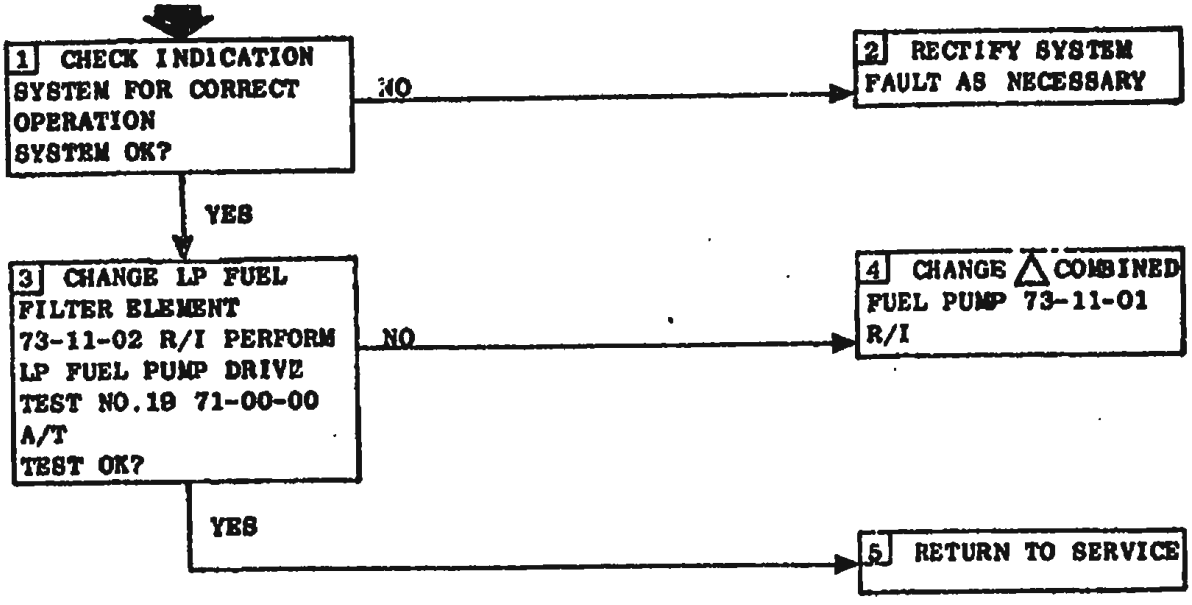
Component Location Index
Fig.101



R
R

Component Locator Diagram
Fig.102

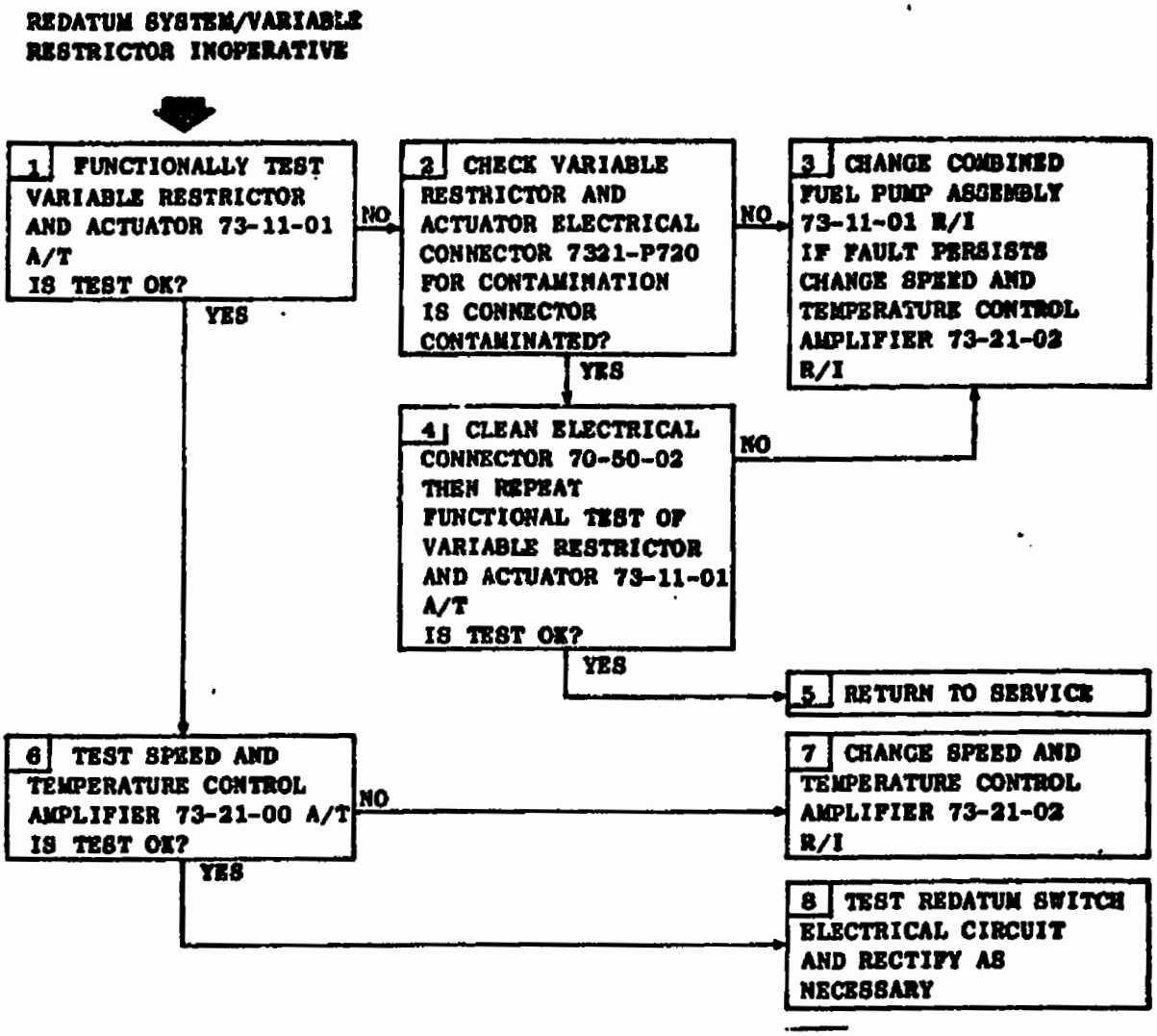
LOW FUEL PRESSURE WARNING LIGHT ON
(WITH OR WITHOUT LOW POWER INDICATIONS)


1 CHECK INDICATION SYSTEM FOR CORRECT OPERATION SYSTEM OK?
NO
2 RECTIFY SYSTEM FAULT AS NECESSARY
YES
3 CHANGE LP FUEL FILTER ELEMENT 73-11-02 R/I PERFORM LP FUEL PUMP DRIVE TEST NO.19 71-00-00 A/T TEST OK?
NO
4 CHANGE △ COMBINED FUEL PUMP 73-11-01 R/I
YES
5 RETURN TO SERVICE

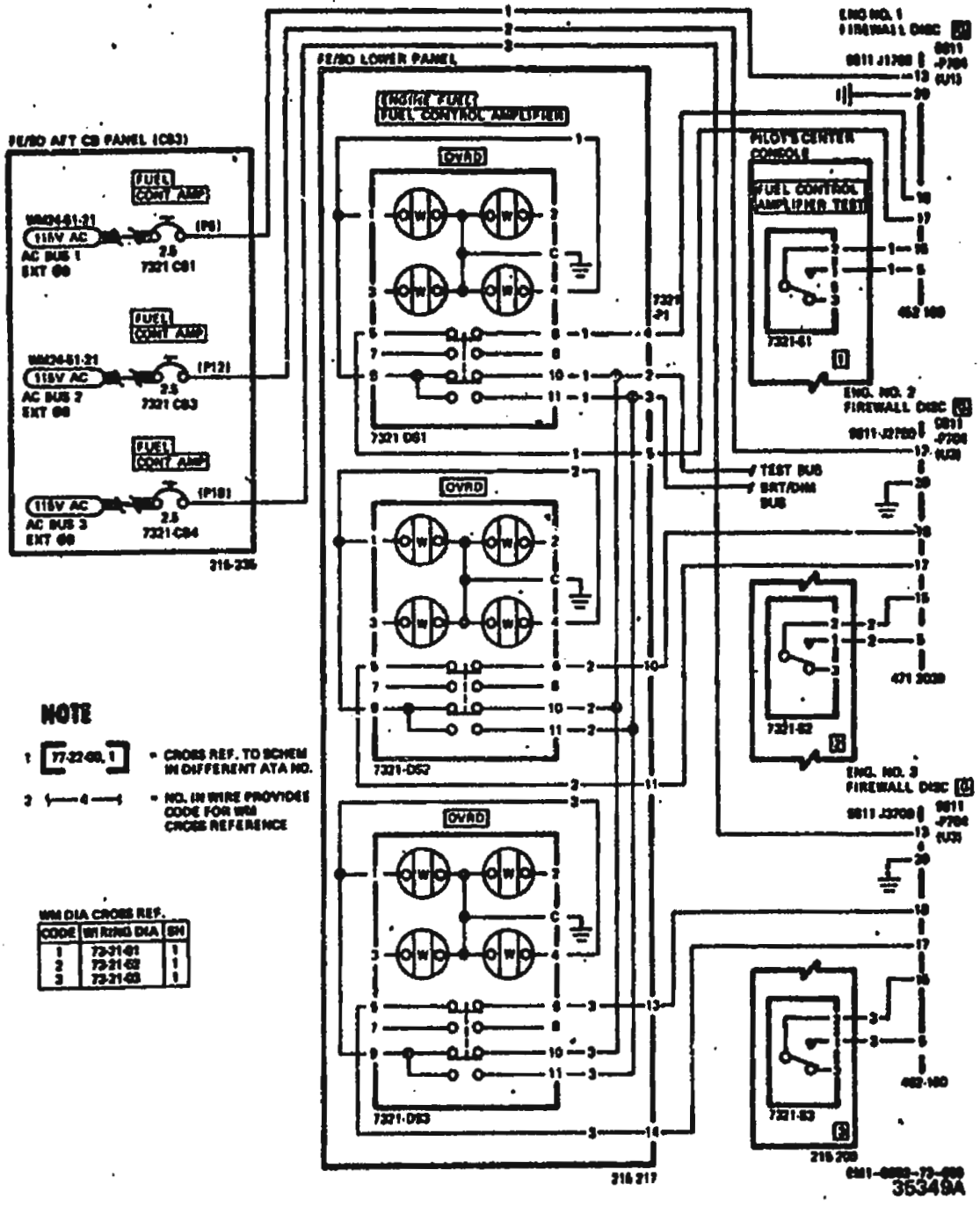
△ NOTE: IF ON UNIT REMOVAL THE FUEL SYSTEM IS FOUND TO BE CONTAMINATED BE METAL OR OTHER FOREIGN DEBRIS, THE FUEL FILTER IN THE H.P. FUEL TUBE TO FUEL SPRAY NOZZLE MANIFOLD (73-11-09 R/I) AND FUEL COOLED OIL COOLER (79-21-02 M/P) MUST BE REPLACED WITHIN 750 HOURS.

A2071

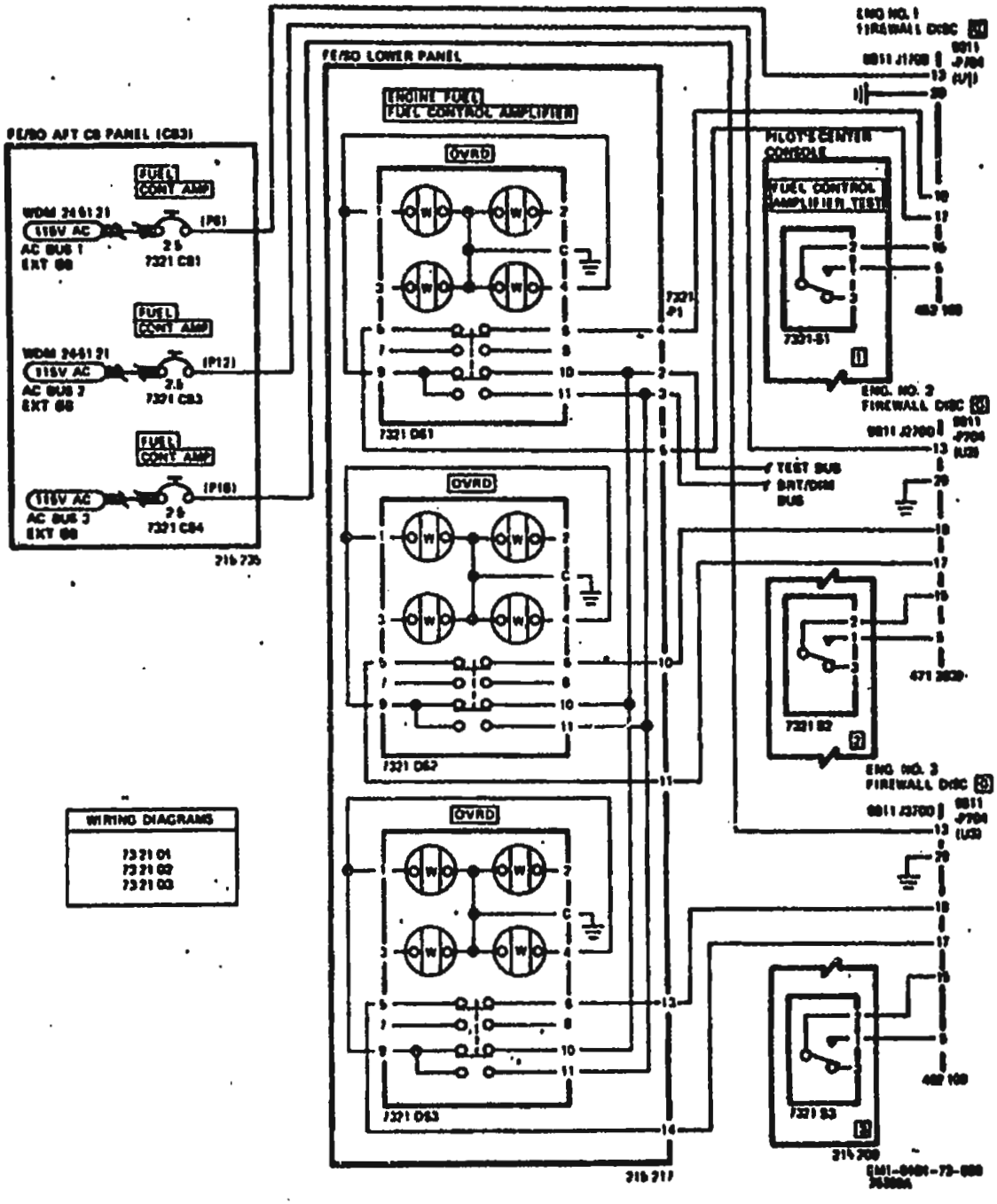
R Low fuel pressure warning light ON
R (with or without low power indication)
R Fig.103


REDATUM SYSTEM/VARIABLE RESTRICTOR INOPERATIVE
1 FUNCTIONALLY TEST VARIABLE RESTRICTOR AND ACTUATOR 73-11-01 A/T IS TEST OK?
NO
YES
2 CHECK VARIABLE RESTRICTOR AND ACTUATOR ELECTRICAL CONNECTOR 7321-P720 FOR CONTAMINATION IS CONNECTOR CONTAMINATED?
NO
YES
3 CHANGE COMBINED FUEL PUMP ASSEMBLY 73-11-01 R/I IF FAULT PERSISTS CHANGE SPEED AND TEMPERATURE CONTROL AMPLIFIER 73-21-02 R/I
4 CLEAN ELECTRICAL CONNECTOR 70-50-02 THEN REPEAT FUNCTIONAL TEST OF VARIABLE RESTRICTOR AND ACTUATOR 73-11-01 A/T IS TEST OK?
NO
YES
5 RETURN TO SERVICE
6 TEST SPEED AND TEMPERATURE CONTROL AMPLIFIER 73-21-00 A/T IS TEST OK?
NO
YES
7 CHANGE SPEED AND TEMPERATURE CONTROL AMPLIFIER 73-21-02 R/I
8 TEST REDATUM SWITCH ELECTRICAL CIRCUIT AND RECTIFY AS NECESSARY
48628

Redatum system/variable restrictor inoperative
Fig.104



Fuel and Control - Controlling (Aircraft No.1002-1028)
Fig.105 (Sheet 1)



Fuel and Control - Controlling (Aircraft No.1029 and up)
Fig.105 (Sheet 2)

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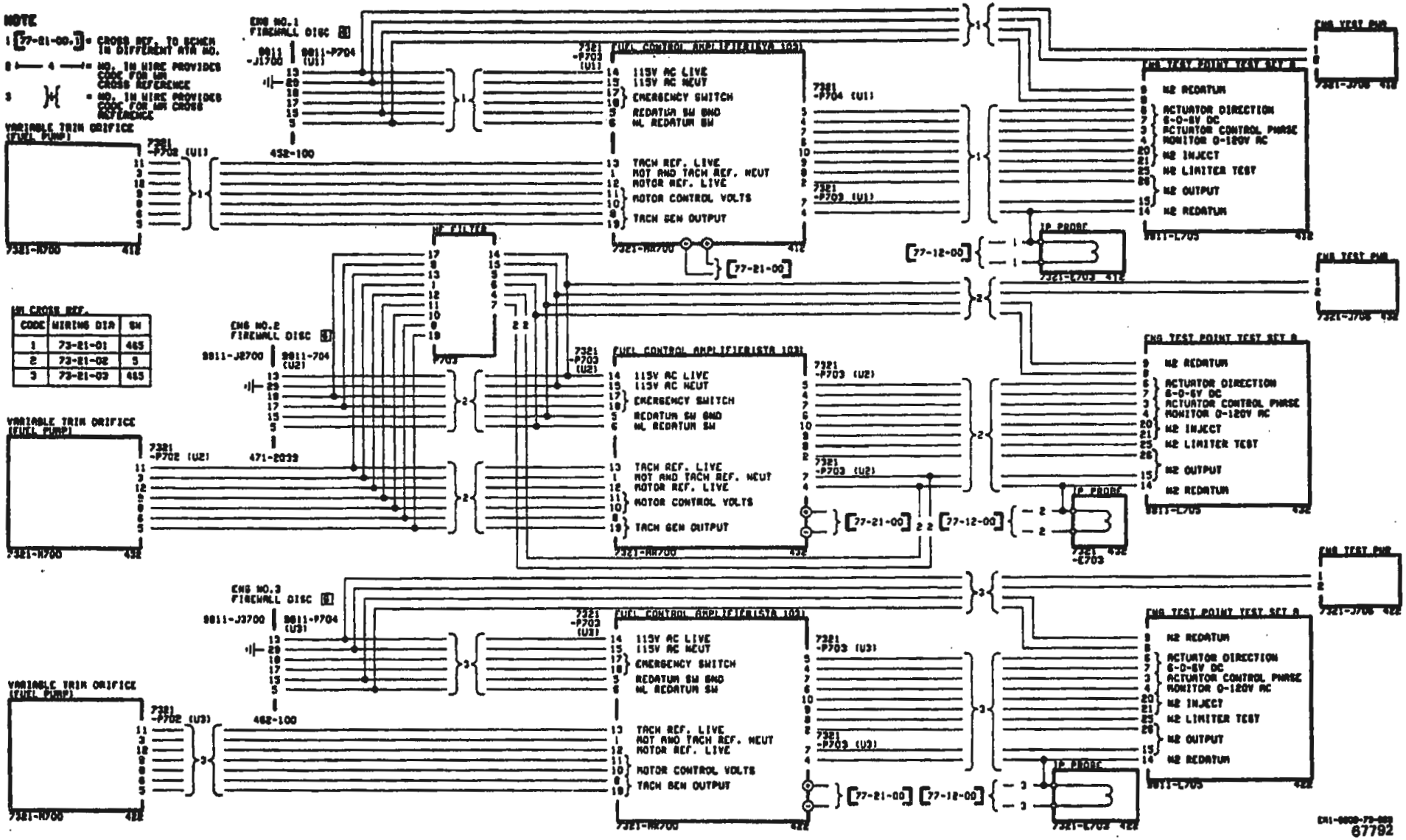
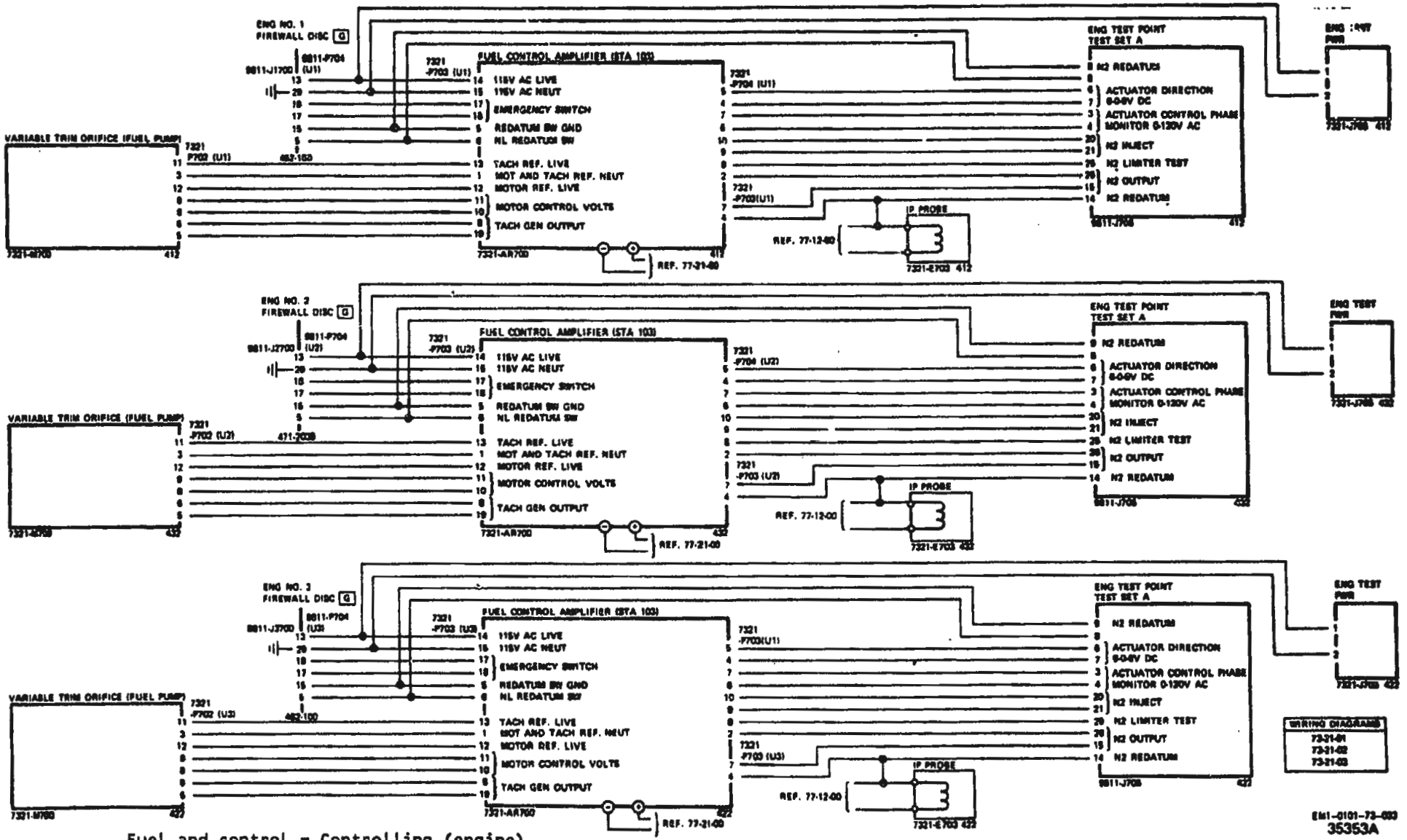
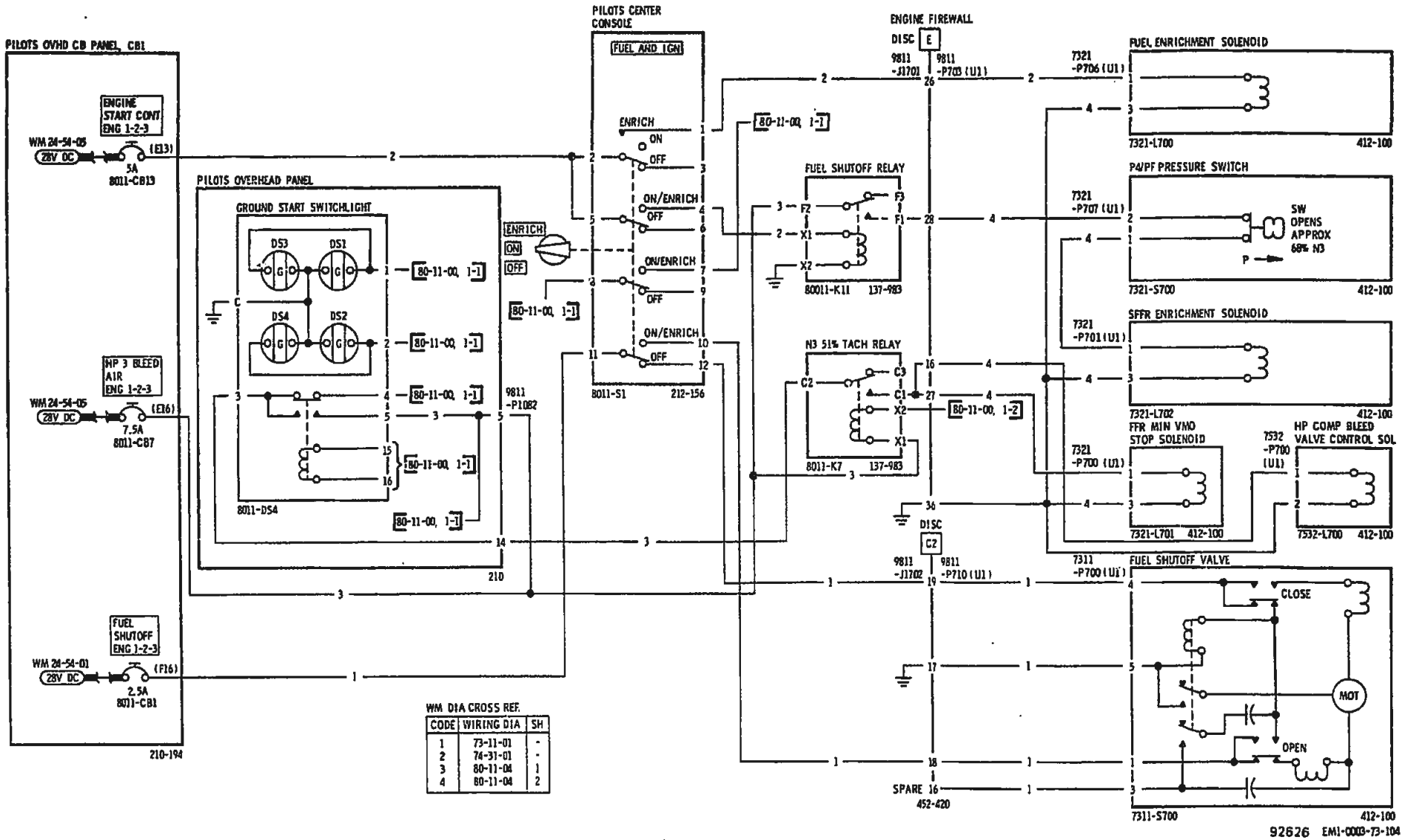


Fuel and control - Controlling (engine)
(Amplifier STA104 and speed switch S8E 10/5)
Fig.106 (Sheet 1)



Fuel and control - Controlling (engine)
(Amplifier STA.103)
Fig.106 (Sheet 2)

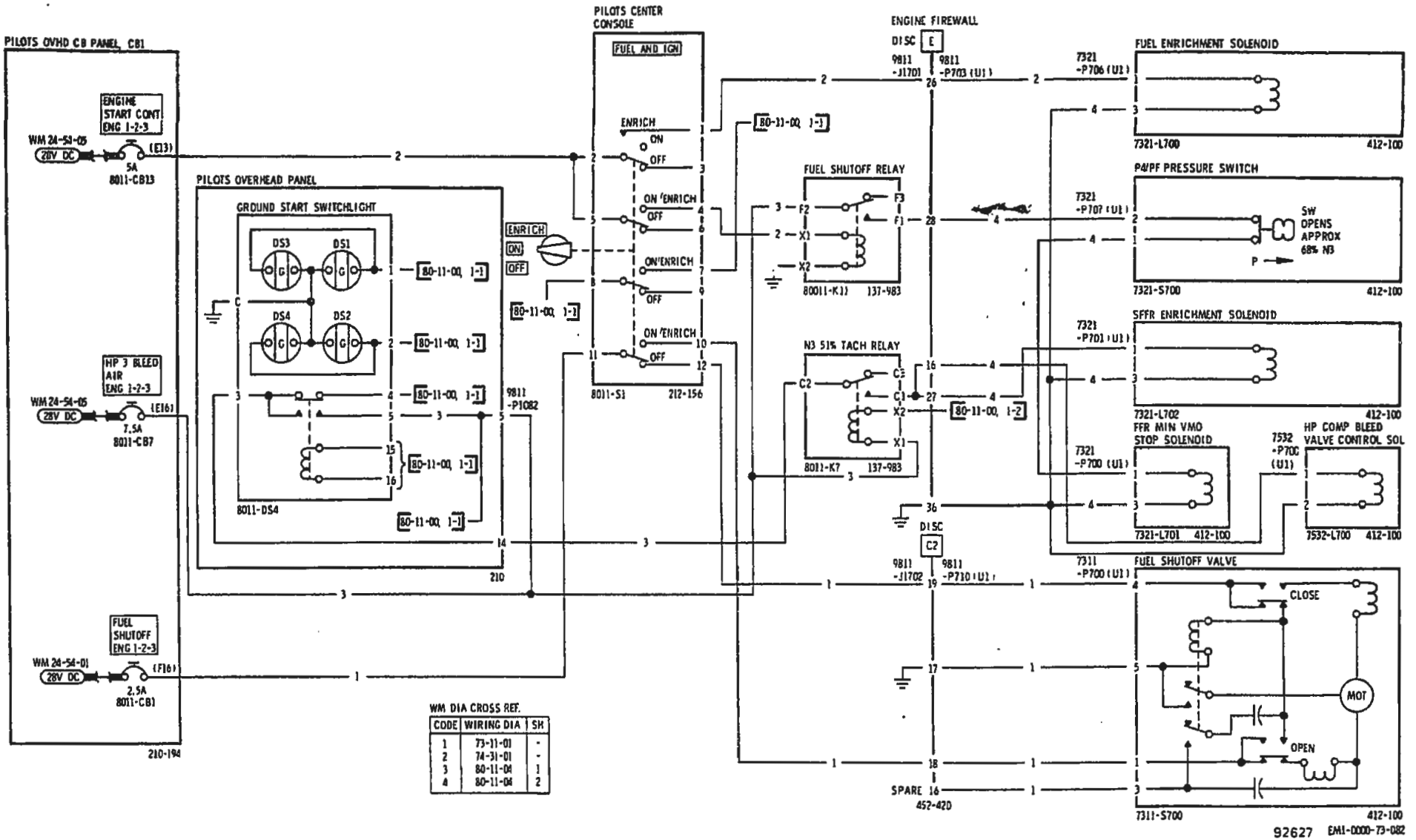


WM DIA CROSS REF.

CODE	WIRING DIA	SH
1	73-11-01	-
2	74-31-01	-
3	80-11-04	1
4	80-11-04	2

R Engine control schematic - Engine No.1
R (Engines without S.B.71-4176 and S.B.71-5474)
R Fig.107 (Sheet 1)

R EFFECTIVITY: ALL

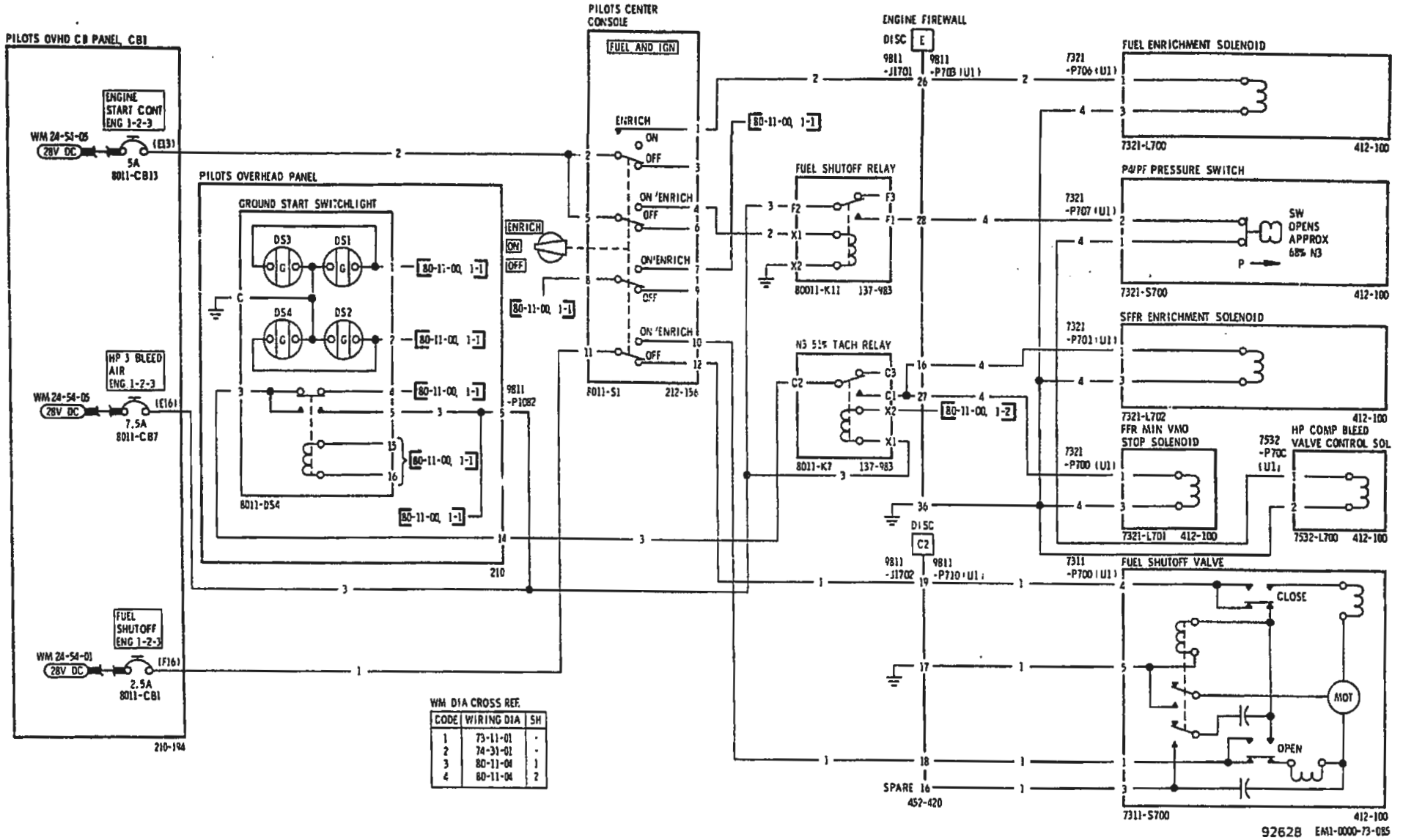


WM DIA CROSS REF.

CODE	WIRING DIA	SH
1	73-11-01	-
2	74-31-01	-
3	80-11-04	1
4	80-11-04	2

R Engine control schematic - Engine No.1
R (Engines with S.B.71-4176 without S.B.71-5474)
R Fig.107 (Sheet 2)

R EFFECTIVITY: ALL

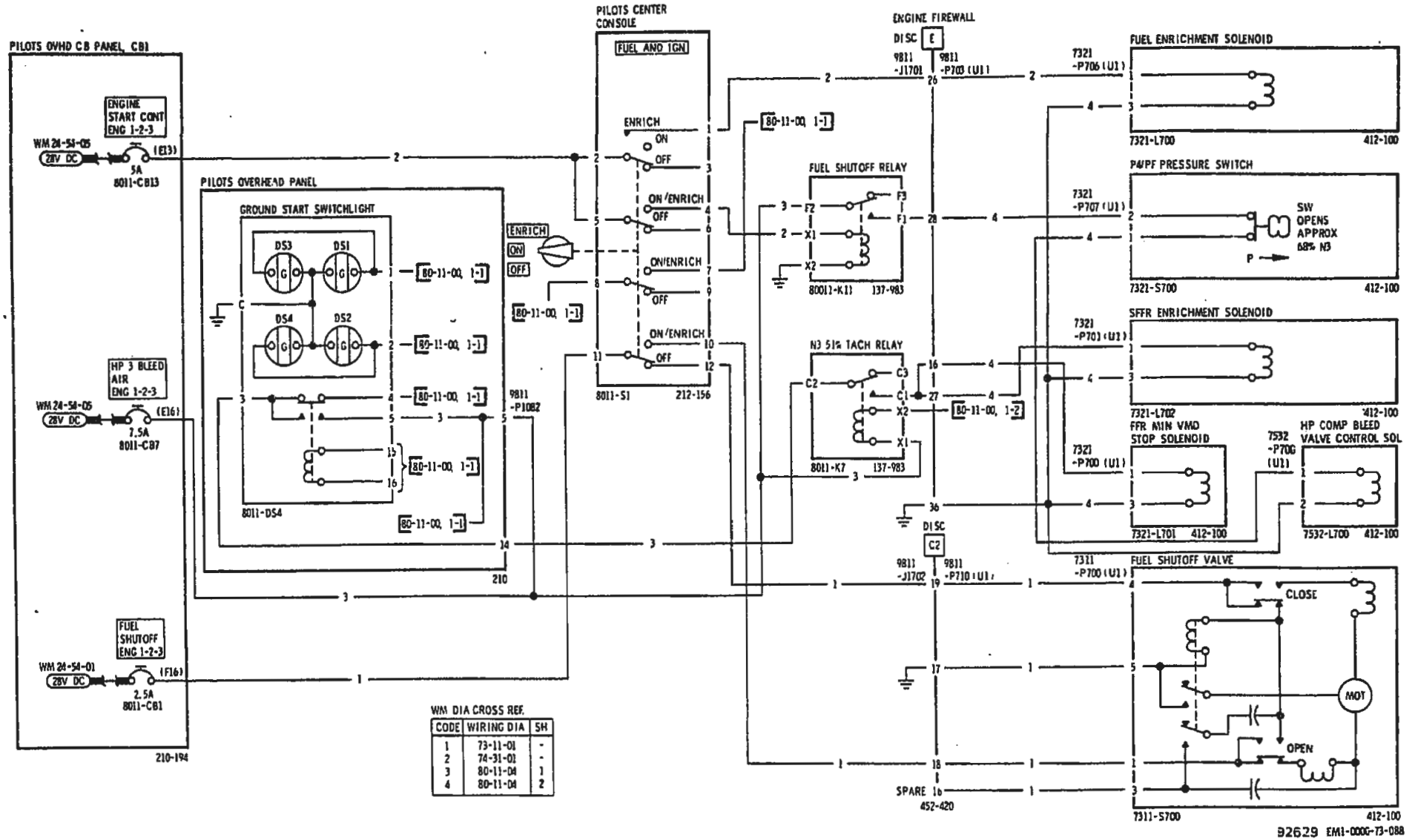


WM DIA CROSS REF.

CODE	WIRING DIA	SH
1	73-11-01	-
2	74-31-01	-
3	80-11-04	1
4	80-11-04	2

R Engine control schematic - Engine No.1
R (Engines without S.B.71-4176 with S.B.71-5474)
R Fig.107 (Sheet 3)

R EFFECTIVITY: ALL

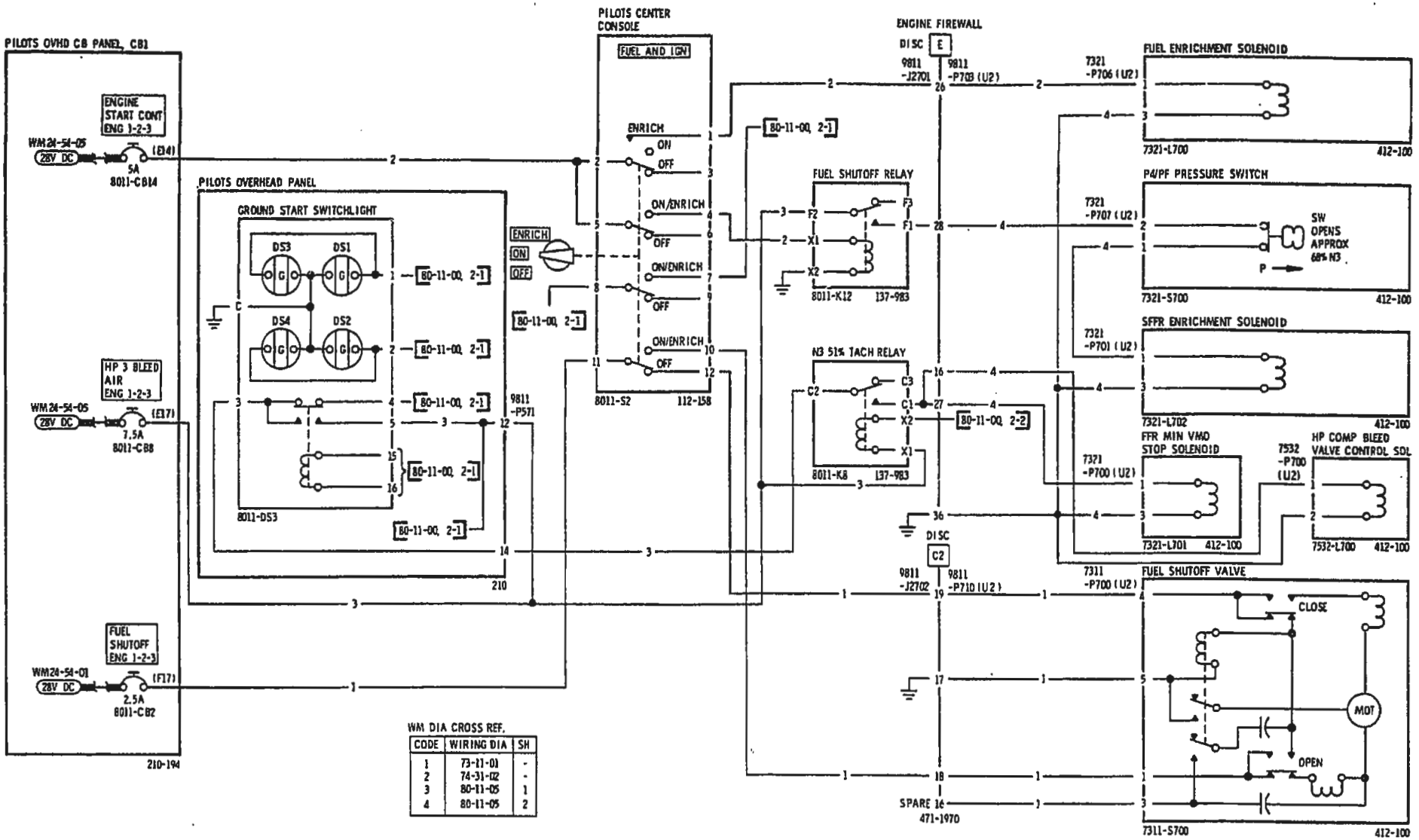


WM DIA CROSS REF.

CODE	WIRING DIA	SH
1	73-11-01	-
2	74-31-01	-
3	80-11-04	1
4	80-11-04	2

R Engine control schematic - Engine No.1
R (Engines with S.B.71-4176 and S.B.71-5474)
R Fig.107 (Sheet 4)

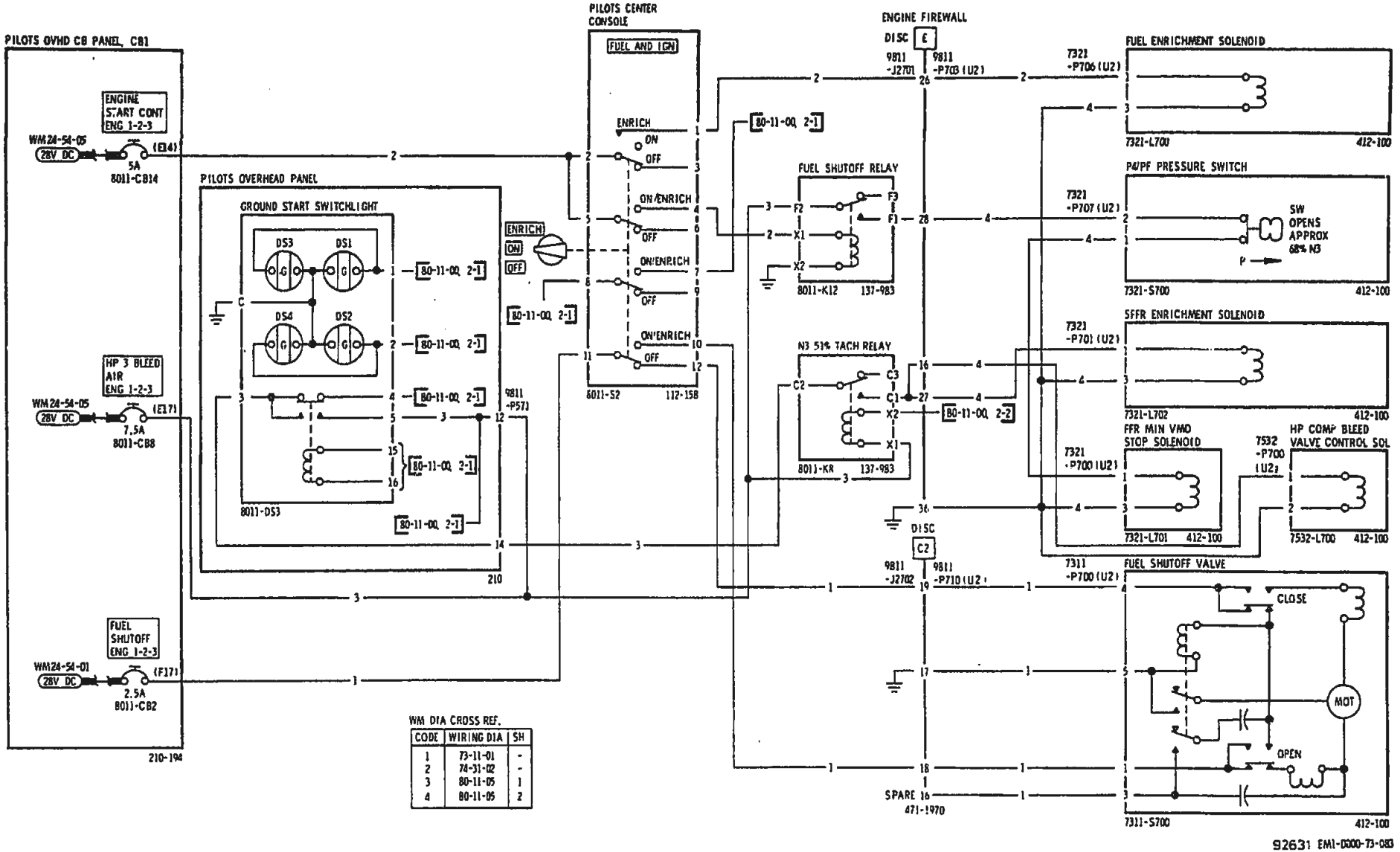
R EFFECTIVITY: ALL
R
050B 1A



92630 EM1-000B-73-102

R Engine control schematic - Engine No.2
R (Engines without S.B.71-4176 and S.B.71-5474)
R Fig.107 (Sheet 5)

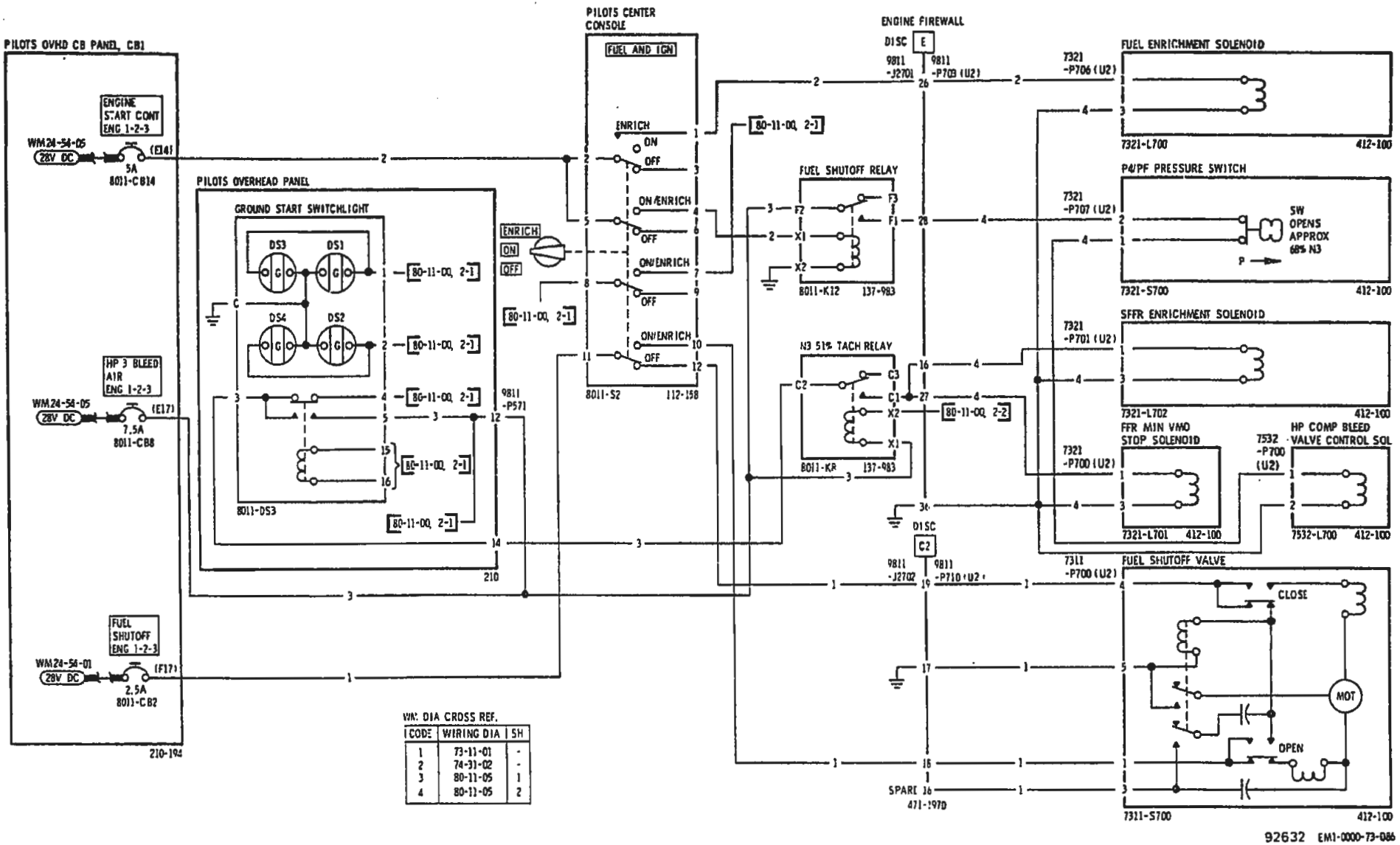
R EFFECTIVITY: ALL
R
050B 1A



92631 EM1-0000-73-083

R Engine control schematic - Engine No.2
R (Engines with S.B.71-4176 without S.B.71-5474)
R Fig.107 (Sheet 6)

R EFFECTIVITY: ALL

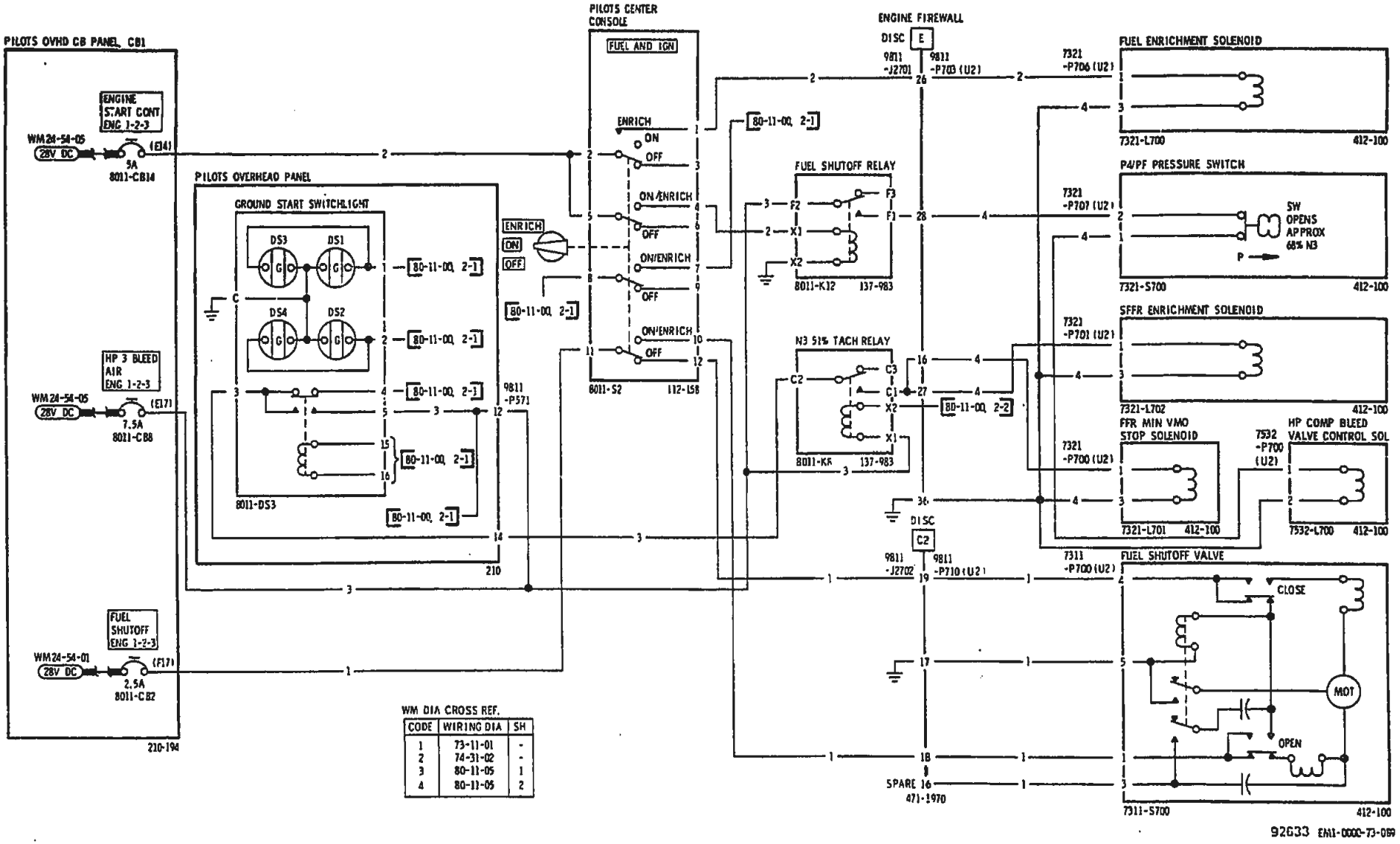


WIRING DIA CROSS REF.

CODE	WIRING DIA	SH
1	73-11-01	-
2	74-31-02	-
3	80-11-05	1
4	80-11-05	2

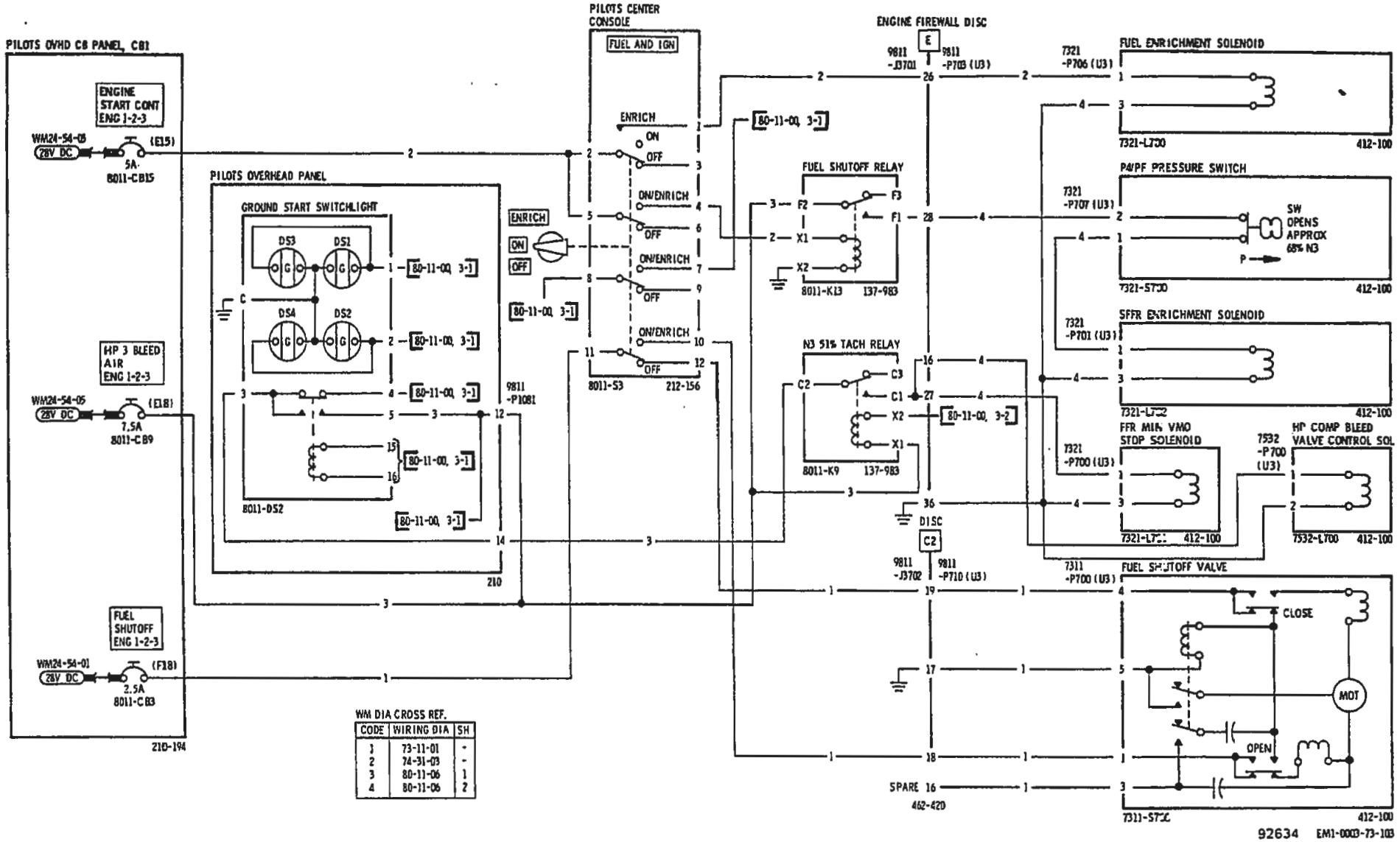
R Engine control schematic - Engine No.2
R (Engines without S.B.71-4176 with S.B.71-5474)
R Fig.107 (Sheet 7)

R EFFECTIVITY: ALL



R Engine control schematic - Engine No.2
R (Engines with S.B.71-4176 and S.B.71-5474)
R Fig.107 (Sheet 8)

R EFFECTIVITY: ALL

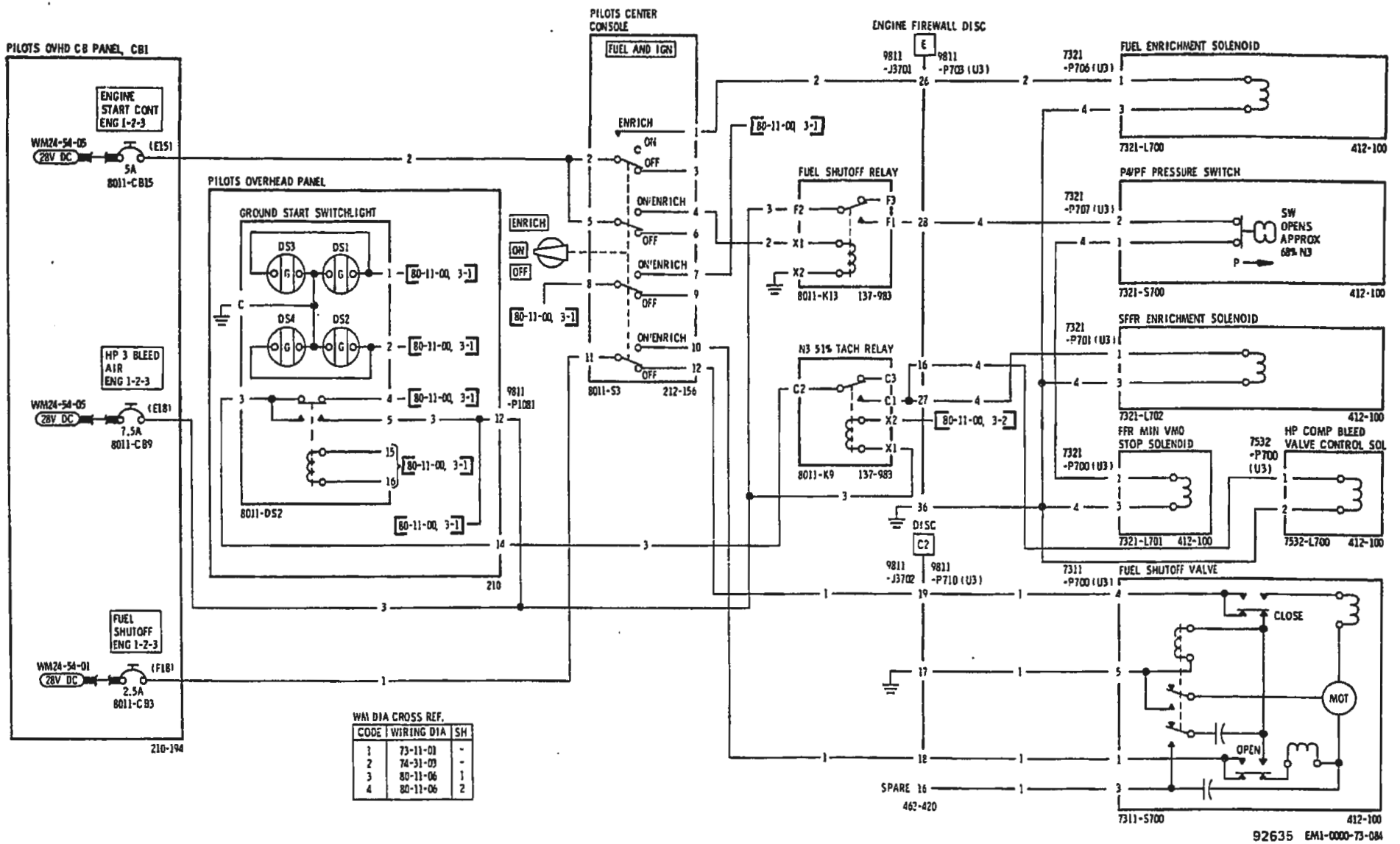


WM DIA CROSS REF.

CODE	WIRING DIA	SH
1	73-11-01	-
2	74-31-03	-
3	80-11-06	1
4	80-11-06	2

R Engine control schematic - Engine No.3
R (Engines without S.B.71-4176 and S.B.71-5474)
R Fig.107 (Sheet 9)

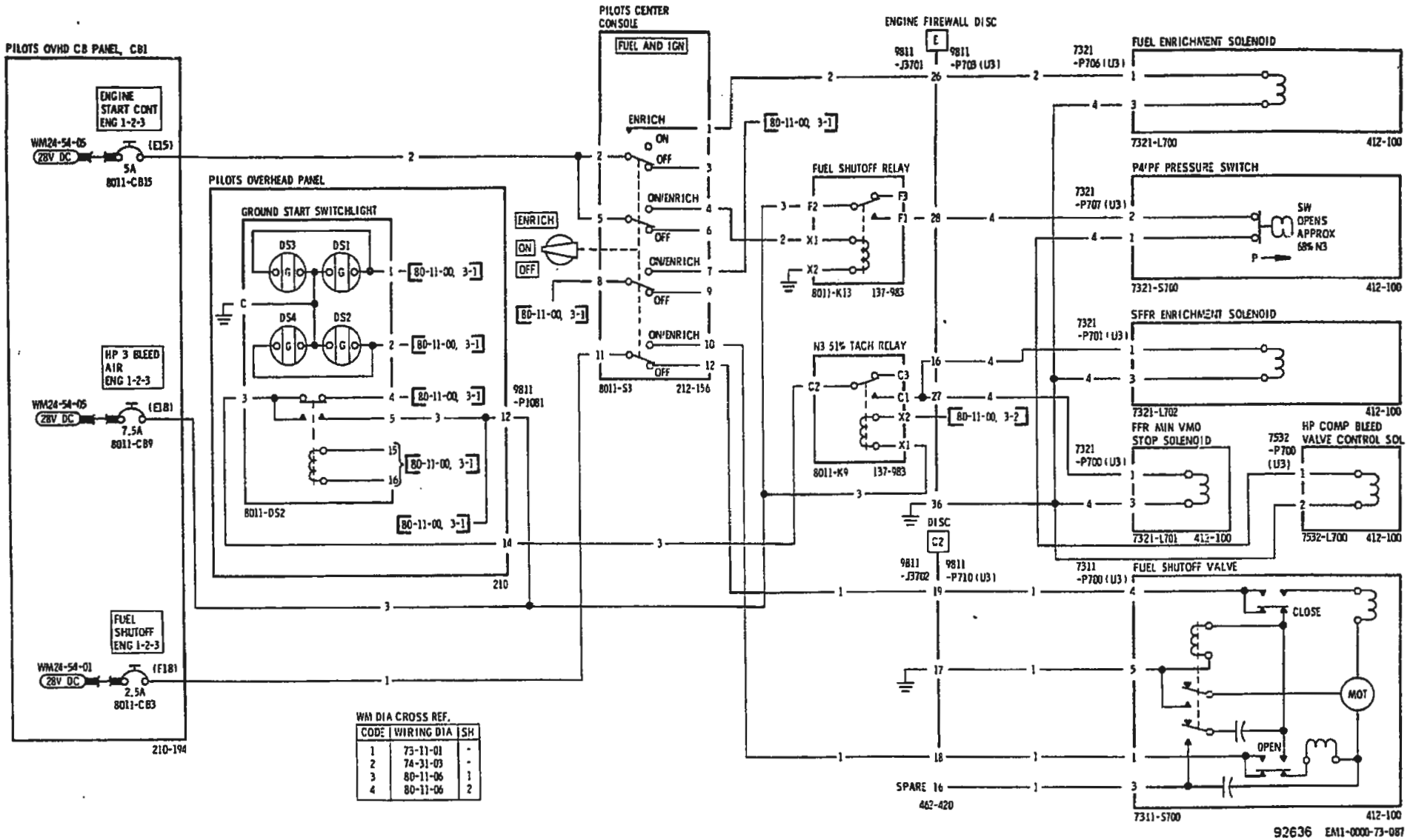
R EFFECTIVITY: ALL



92635 EM1-0000-73-084

R Engine control schematic - Engine No.3
R (Engines with S.B.71-4176 without S.B.71-5474)
R Fig.107 (Sheet 10)

R EFFECTIVITY: ALL

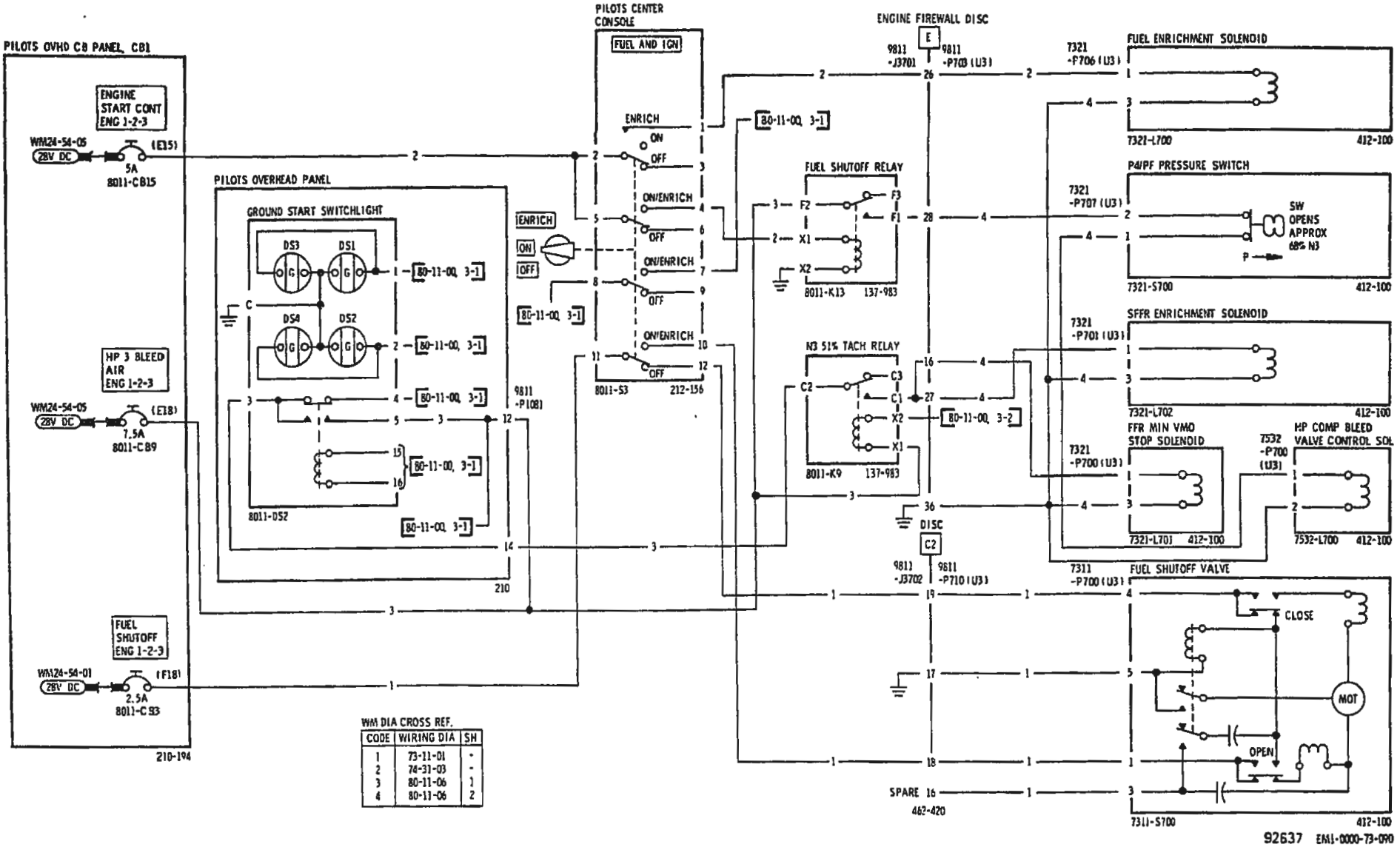


92636 EM1-0000-73-087

R Engine control schematic - Engine No.3
R (Engines without S.B.71-4176 with S.B.71-5474)
R Fig.107 (Sheet 11)

R EFFECTIVITY: ALL

R
050B 1A



R Engine control schematic - Engine No.3
R (Engines with S.B.71-4176 and S.B.71-5474)
R Fig.107 (Sheet 12)

R EFFECTIVITY: ALL

R ENGINE FUEL AND CONTROL - MAINTENANCE PRACTICES

CR 1. Cast Directionally Solidified (DS) Turbine Modification and
CR *Effect on Fuel Accessories*

CR A. The Cast D/S Turbine program brings along with it four
CR changes in the fuel system components that must be brought
CR to your attention so the problems of intermixing of
CR components may be kept to a minimum.

CR B. Because of the increased airflow through the core engine
CR after modification, the fuel flow required for starting
CR must be revised.

CR (1) The fuel flow regulator must be recalibrated to
CR provide the additional fuel required for starting.
CR Therefore, a new TWA Stk. Nbr. 29219.

CR (2) The start control unit (SCU) enrichment flow has been
CR decreased and the point at which the enrichment flow
CR cuts out has been changed. A minor modification to
CR the small heatshield is being accomplished also.
CR The new TWA Stk. Nbr. is 29222.

CR (3) The cold day enrichment flow is being revised by a
CR tubing change such that the cold day enrichment fuel
CR can be applied during light-up and through the entire
CR start cycle. No change or part number change is made
CR in the motorized shut off cock - TWA Stk. Nbr.29217.

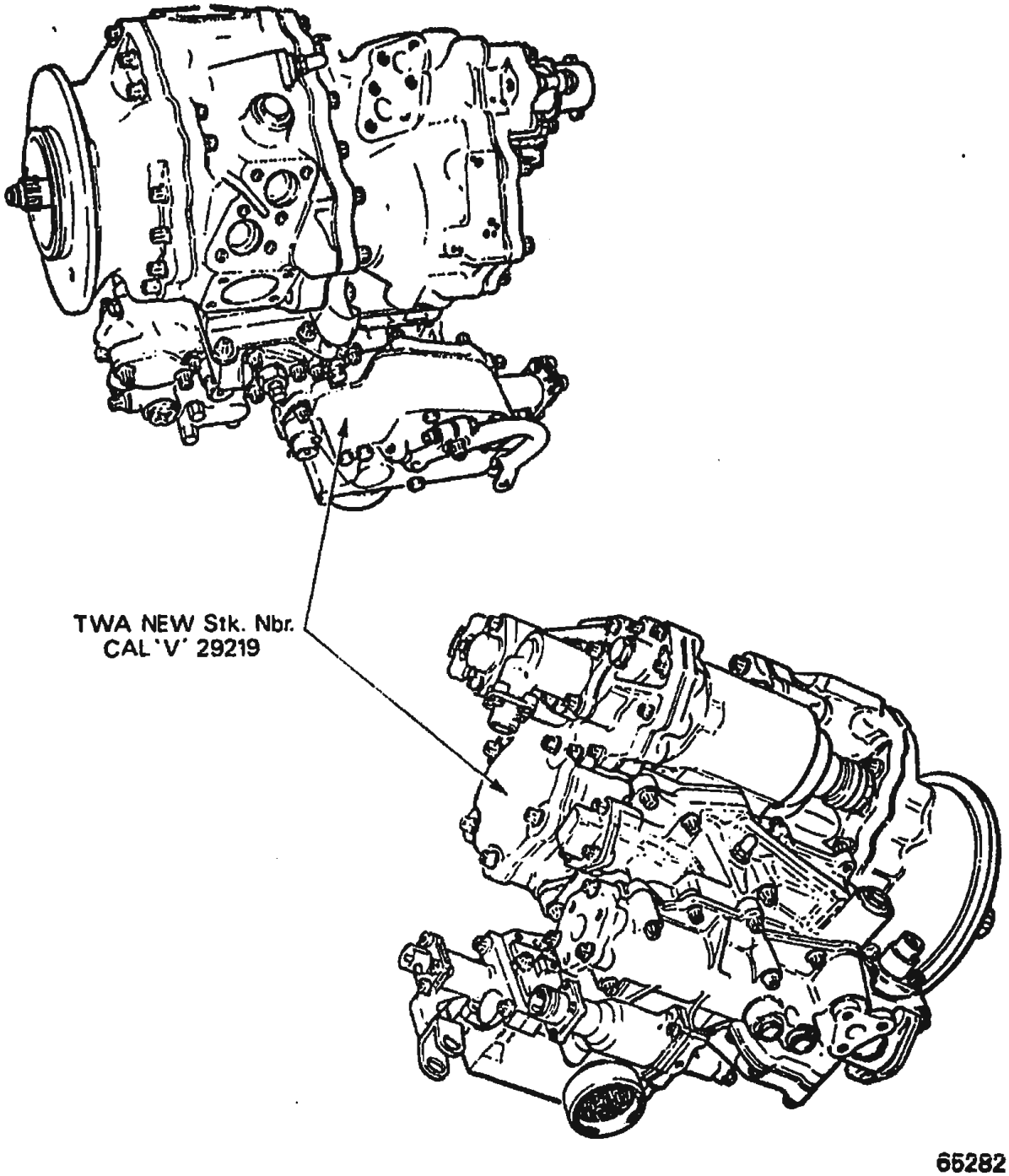
CR (4) An electrical harness revision has been introduced that
CR changes: the closing of the HP3 bleed valve, the
CR positioning of the min F/N stop and the start control
CR unit cut-off point.

CR C. The recalibration of the fuel flow regulator is an internal change of orifices, venturi and half-ball valves necessitating a new calibration called 'V' on the test stand. Unfortunately there is no quick way to do this job in the field. Modified units will be identified by 'Cal 'V' 29219' painted in two locations - the throttle box cover and the end cover of the fuel side - on the FFR. (See Figure 201).

CR (1) A modified FFR - TWA Stk. Nbr. 29219 - and an unmodified FFR - TWA Stk. Nbr. 29214 - are not fully interchangeable. The interchangeability is in one direction only - that is, the modified - 29219 - unit may be used on an unmodified engine but the unmodified - 29214 - unit can not be used on a modified engine. It is now obvious, that until all engines are converted to the cast D/S configuration, two FFR configurations, will be required. At 69,000 each, no spare units will be purchased to handle the temporary additional requirement. With the use of good trouble shooting techniques, a reduction of unjustified or unnecessary removals, and judicious use of spare units our present number of units will suffice. This is not only a challenge but a fact of life. Two of our existing spare 29214 FFR's will be modified to 29219 units and placed at LAX and JFK for the start of the cast D/S program.

CR (2) If a modified FFR - 29219 - is to be installed on an unmodified engine the SCU enrichment orifice adjustment position must be checked. If the adjustment is flush or out past flush, the engine most certainly will experience a hot start if the adjustment is not turned a minimum of 1/2 turn clockwise below flush. Further adjustments may be made to correct slow or hot starts.

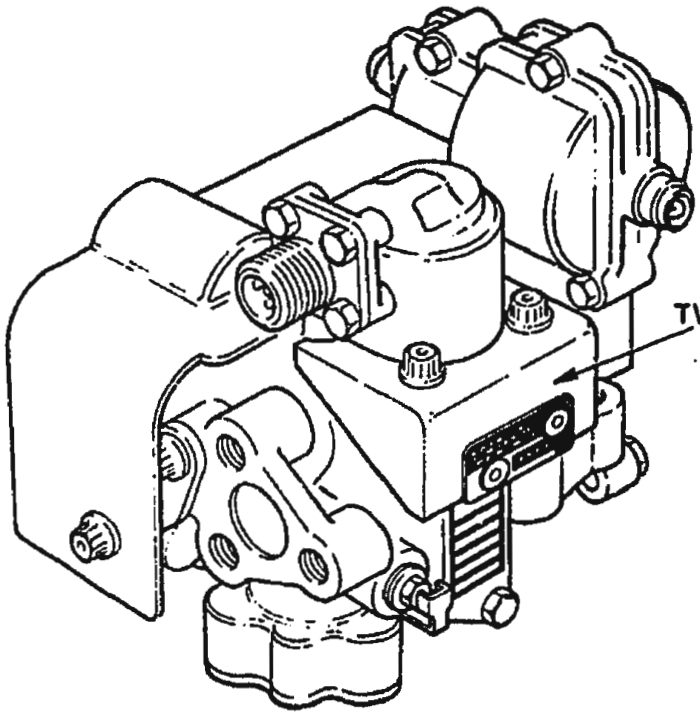
CR (3) Figure 205 outlines the action and precautions to be taken when an FFR - modified or unmodified is installed on a modified or unmodified engine with a modified or unmodified SCU.



CR
CR
Fuel Flow Regulator
Fig.201

R EFFECTIVITY: ALL
R
050B

1G



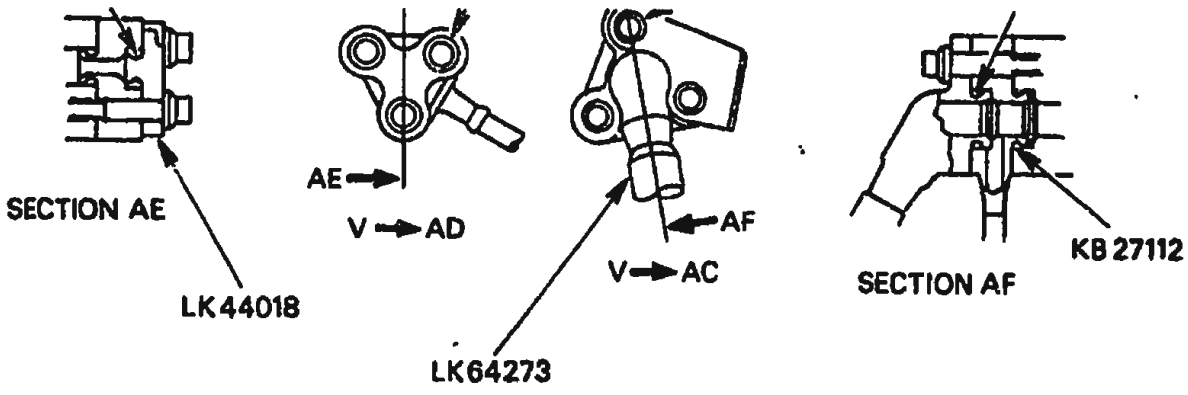
65283

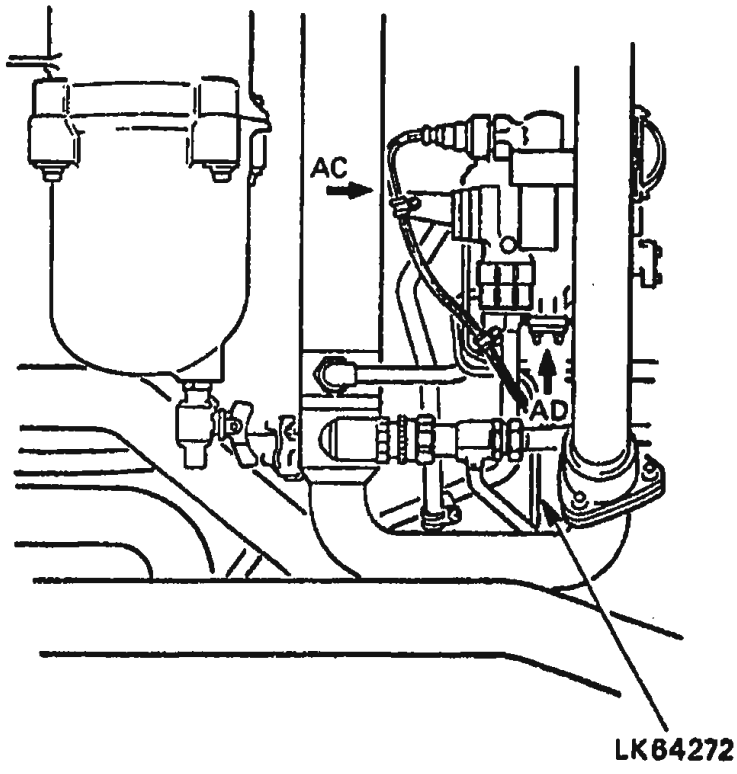
CR Start Control Unit (SCU)
CR Fig.202

R EFFECTIVITY: ALL
R
050B 1G

CR D. The modified Start Control Unit will carry the manufacturers part number of SCU 101-MK 7. The new TWA Stk. Nbr. will be 29222. This number will be stamped on the small heatshield on the base of the enrichment solenoid and is visible when the unit is installed. An unmodified SCU, TWA Stk. Nbr. 29218 and a modified SCU, TWA Stk. Nbr. 29222 may be used interchangeably on an unmodified engine. The SCU installation on the modified engine is plumbed slightly different from the unmodified engine to accomodate the 'F' type cold day enrichment. The 'VMO' port on the modified SCU is blanked off and the associated tubing rerouted. The blanking plate used on the 'VMO' port has a manufactures part number of LK44018 and a TWA Stk. Nbr. of 61-3406. The blanking plate has been allocated to all L1011 stations for use on modified engines. SCU's in stock, modified or unmodified, will not be equipped with the blanking plate at this time. If a modified SCU is to be replaced on a modified engine, the blanking plate should be transferred from the old unit to the new. The blanking plates in stock are really for insurance purposes at the early stage of this modification and eventually all 29222 units will be equipped with the blanking plate when placed in stock.

CR E. The cold day enrichment flow is being revised by removing line P/N LK41407, blanking off the 'VMO' port of the SCU or start fuel flow regulator and installing two new tubes, LK64272. TWA Stk. Nbr. 60-5727, and LK64273, TWA Stk. Nbr. 60-5728. Figure 203 shows the tubing configurations. The cold day enrichment installation known as 'F Type' CDE is useable on either pre-cast D/S engines or cast D/S engines. No tubing changes are required if a cast D/S engine is converted back to the pre-cast D.S. turbine configuration.





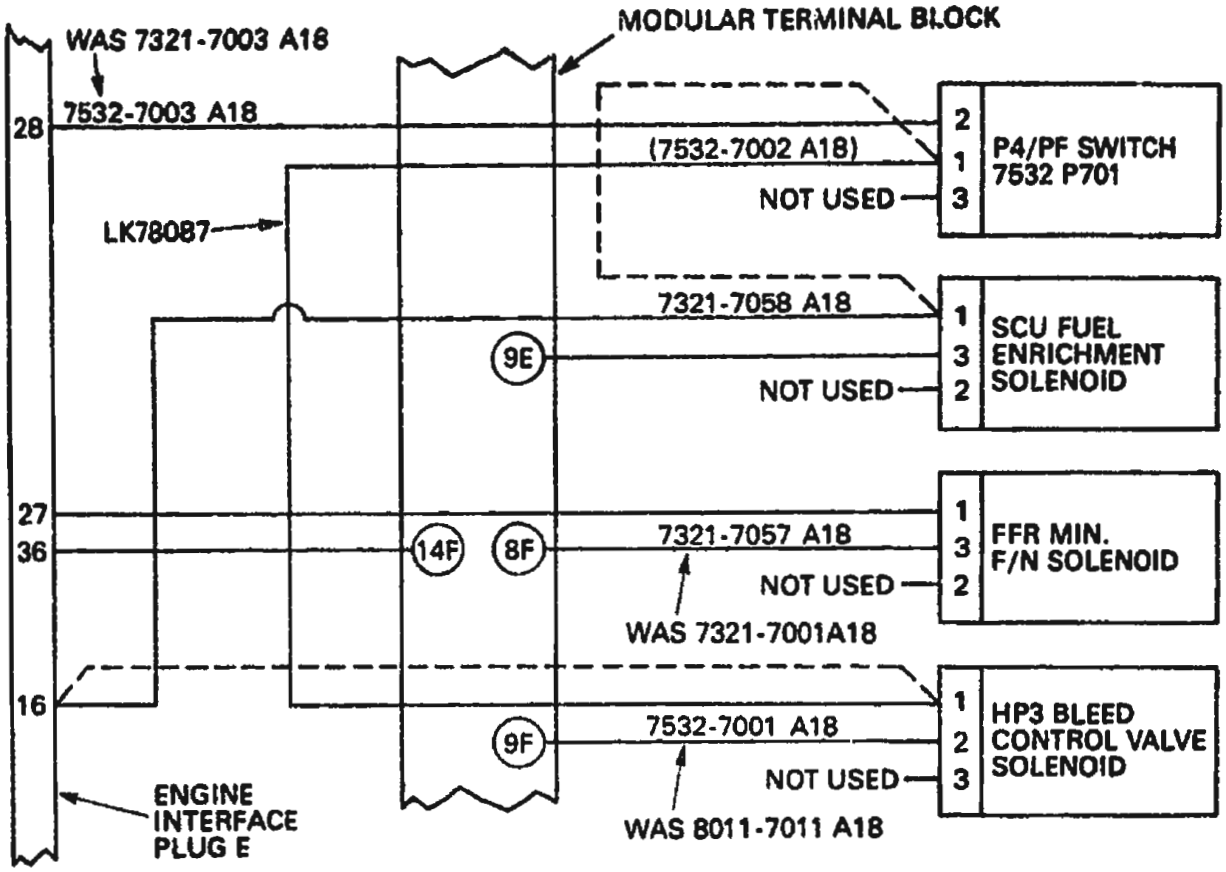
66284

CR Cold Day Enrichment
CR Fig.203

CR F. The catagory 2 loom assembly, Rolls Royce P/N LK 50886, TWA Stk. Nbr. 261-0025 is modified to accomodate two changes. The start control unit that originally was controlled by the P4/Pf switch cutting out at 68% N3 is now controlled by the N3 51% tach switch cutting out at 51% N3. The HP3 bleed control solenoid was originally controlled by the 51% N3 switch is now controlled by the P4/Pf switch and will be closing at 68% N3.

CR G. Figure 204 shows the wiring changes. Wiring diagrams 80-11-04, 80-11-05, and 80-11-06 Pages 1 through 4 will also reflect these changes in a future revision.

CR H. One very important thing to keep in mind. If a cast D/S turbine engine is converted back to a non-cast D/S engine, the wiring must be revised back to the original configuration. To facilitate easy conversion back to the original configuration, unused wires and excess wiring has been taped and stowed in the loom.



WIRING DIAGRAM

DOTTED LINES INDICATE LEADS PRIOR TO ALTERATION 65285

CR
CR
Wiring Diagram
Fig.204

R EFFECTIVITY: ALL
R
050B 1G

ENGINE CONFIGURATION / UNIT CONFIGURATION	Unmodified Engine Unmodified FFR Unmodified SCU	Unmodified Engine Unmodified FFR Modified SCU	Unmodified Engine Modified FFR Unmodified SCU	Unmodified Engine Modified FFR Modified SCU	Modified Engine Modified FFR Modified SCU	Modified Engine Modified FFR Unmodified SCU	Modified Engine Unmodified FFR Unmodified SCU See Note Below	Modified Engine Unmodified FFR Modified SCU *See Note Below
To Install Unmodified FFR Mgr.P/N FFR 101-MK5 TWA Stk.Nbr.29214	Install FFR Nothing Changed From Present Handling	Install FFR Adjust SCU Enrichment Orifice Flush With Reach Nut	Install FFR Adjust SCU Enrichment Orifice Flush With Reach Nut	Install FFR Adjust SCU Enrichment Orifice Flush With Reach Nut	Do Not Install Unmodified FFR On Modified Engine	Do Not Install Unmodified FFR On Modified Engine	Do Not Install Unmodified FFR On Modified Engine	Do Not Install Unmodified FFR On Modified Engine
To Install Modified FFR Mfg.P/N FFR 101-MK10 TWA Stk.Nbr.29219	Install FFR Adjust SCU Minimum of 1/2 Turn Clockwise below Nut. Be Alert For Hot or Slow Start Next Run-up. **	Install FFR Adjust SCU Minimum of 1/2 Turn Clockwise below Nut. Be Alert For Hot or Slow Start Next Run-up. **	Install FFR Adjust SCU Minimum of 1/2 Turn Clockwise below Nut. Be Alert For Hot or Slow Start Next Run-up. **	Install FFR Check Adjustment of SCU Enrichment Orifice. Should Be OK as is. Be Alert For Hot Start Next Run-up.	Install FFR Check Adjustment of SCU Enrichment Orifice. Should Be OK as is.	Install FFR Check Adjustment of SCU Enrichment Orifice. Should Be OK as is. If Adjusting Screw Extends Beyond Reach Nut, Adjust to Flush With Reach Nut	Install FFR Check Adjustment of SCU Enrichment Orifice. Should Be Below Reach Nut Minimum of 1/2 Turn. Be Alert for Hot Start Next Run-up.	Install FFR Check Adjustment of SCU Enrichment Orifice. Adjustment should Be Flush With Reach Nut.

NOTES: Modified engines may be identified by 3in. high letters 'CDS' painted on left side of fan case in area of the oil filter cap on the gearbox.

Modified FFR's may be identified by TWA Stk.Nbr.29219 painted on FFR throttle box and on end cover of fuel side of FFR. 'CAL V' is also painted adjacent to stock numbers.

Modified SCU's may be identified by TWA Stk.Nbr.29222 stamped on the heatshield above the unit identification plate. Also the identification plate is marked 'SCU 101 Mark 7'.

SPECIAL NOTE: Originally modified engines that have been demodified (No longer cast D/S) must have wiring converted back to original configuration.

Wiring involves cut out point of SCU - 51% versus 68%, HP3 bleed solenoid 68% versus 51%.

See L1011 wiring diagram 80-11-04, 80-11-05 and 80-11-06, Pages 1, 2, 3 and 4 for details.

* This is a condition that should not exist. However, unit may have been installed during trouble shooting of squawk.

** With SCU adjusted 1/2 turn below Reach Nut a normal to warm start may be noted.

66810

CR CR Configuration interchangeability
Fig.205

R R 050B EFFECTIVITY: ALL 1G

ENGINE FUEL AND CONTROL - SERVICING

Service Bulletin referred to:

S.B.73-4473 - Drain valve replaced by drain plug
R S.B.73-8105 - Fuel System - L.P. inlet pipe addition of Flange heat
R shield and pipe insulation.

Referenced Procedures

24-41-00	External Power/Ground Service System - Maintenance/ Practices
70-02-01	Identification, Lubrication and Fitting of Rubber Sealing Rings
71-00-00	Power Plant - Adjustment/Test
71-11-00	Cowlings, Engine No.1 and No.3 - Servicing
71-12-01	L.H. and R.H. Lower Hinged Cowl - Servicing
72-00-00	Engine - Servicing

Illustrated Parts Catalogue References

The I.P.C. sections where parts disturbed during the following operations can be located are as follows:

73-11-02	L.P. Fuel Filter
73-11-09	L.P. Fuel Tubes

1. Drain L.P. Fuel System

A. Drain L.P. Fuel Supply Tube

(1) Equipment required:

Clean receptacle - minimum capacity

5 U.S. gallons
4 Imperial gallons
18 Litres

(2) Material required:

	British Spec./Ref.	American Spec./Ref.	OMat Item No.
Lockwire	D.T.D.189A 22 S.W.G.	- 21 A.W.G.	238

(3) Open left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL for engine No.2 (Ref. 71-12-01).

(4) Refer to A, fig.301, position receptacle then remove drain plug.

(5) Fit and lubricate (Ref. 70-02-01) a new seal ring to drain plug.

(6) When fuel flow ceases, fit and secure drain plug and wirelock.

(7) Close left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL for engine No.2 (Ref. 71-12-01).

B. Drain Engine L.P. Fuel System

(1) Equipment required:

Clean receptacle - minimum capacity

5 U.S. gallons
4 Imperial gallons
18 Litres

(2) Material required:

	British Spec./Ref.	American Spec./Ref.	OMat Item No.
Lockwire	D.T.D.189A 22 S.W.G.	- 21 A.W.G.	238

R (3) Engines with S.B.73-4473

(a) Refer to B. fig.301, position receptacle then remove drain plug from fuel filter.

(b) Fit new seal ring to drain plug and when fuel flow ceases fit and secure drain plug and wirelock.

R (4) Close left-hand hinged cowl 412A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL for engine No.2 (Ref. 71-12-01).

2. Prime L.P. Fuel System

A. Prime L.P. Fuel Supply Tube

(1) Equipment required:

Clean receptacle - minimum capacity

5 U.S. gallons
4 Imperial gallons
18 Litres

(2) Material required:

	British Spec./Ref.	American Spec./Ref.	OMat Item No.
Lockwire	D.T.D.189A 22 S.W.G.	-	238
		21 A.W.G.	

(3) Open left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL for engine No.2 (Ref. 71-12-01).

(4) Refer to A, fig.301, position receptacle then remove drain plug.

(5) Fit and lubricate (Ref. 70-02-01) a new seal ring to drain plug.

(6) Connect and energize external power system (Ref. 24-41-00).

(7) Select relevant ENG TANK VALVE switchlight open, zone 215.

(8) Select relevant TANK PUMP switchlight on, zone 215.

(9) When a full and air-free fuel flow is achieved from drain plug orifice, fit and secure drain plug then wirelock.

(10) Select TANK PUMP switchlight off.

(11) Select ENG TANK VALVE switchlight closed.

(12) De-energize external power system (Ref. 24-41-00).

(13) Close left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL for engine No.2 (Ref. 71-12-01).

B. Prime Engine L.P. Fuel System

(1) Equipment required:

Clean receptacle - minimum capacity

5 U.S. gallons
4 Imperial gallons
18 Litres

Flexible hose - approximate length 72in. (1800 mm.)
internal diameter 0.5in. (12 mm.)

(2) Material required:

	British Spec./Ref.	American Spec./Ref.	OMat Item No.
Lockwire	D.T.D.189A 22 S.W.G.	- 21 A.W.G.	238

(3) Open left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433 AL for engine No.2 (Ref. 71-12-01).

R (4) Engines with S.B.73-4473

(a) Refer to B. fig.301, position receptacle then remove drain plug from fuel filter.

(b) Fit and lubricate (70-02-01) new seal ring to drain plug.

R (5) Connect and energize external power system (Ref. 24-41-00).

R (6) Select relevant ENG TANK VALVE switchlight open, zone 215.

R (7) Select relevant TANK PUMP switchlight on, zone 215.

R (8) On engines with S.B.73-4473, when a full and air-free fuel flow is achieved, fit and secure drain plug and wirelock.

R (9) Select TANK PUMP switchlight off.

R (10) Select ENG TANK VALVE switchlight closed.

R (11) De-energize external power system (Ref. 24-41-00).

R (12) Close left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL for engine No.2 (Ref. 71-12-01).

3. Inhibit Engine Fuel System

A. Equipment required

Clean receptacle - minimum capacity

5 U.S. gallons
4 Imperial gallons
18 Litres

B. Material required:

		British Spec./Ref.	American Spec./Ref.	OMat Item No.
	Lockwire	D.T.D.189A 22 S.W.G.	-	238
			21 A.W.G.	
R	Mineral oil		MIL-L-6081C	1024A
R				1024C
R				1024D
		or		
C		Stk Nbr		
C		TWA 50-0842		

Dry compressed air supply - minimum pressure 60 p.s.i.g.

C C. Deleted

D. Prepare Engine for Inhibiting

(1) Open left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL for engine No.2 (Ref. 71-12-01).

(2) Open relevant circuit breakers to isolate electrical supply to ignition system.

(3) Refer to A, fig.301, position clean receptacle then remove drain plug and drain L.P. fuel supply tube.

(4) Fit and lubricate (Ref. 70-02-01) a new seal ring to drain plug.

(5) When fuel flow ceases, fit and secure drain plug then wirelock.

(6) Engines with S.B.73-4473

(a) Refer to B, fig.301, position receptacle then remove drain plug from L.P. fuel filter.

(b) Fit and lubricate (70-02-01) new seal ring to drain plug.

R (7) Engines without S.B.73-8105 disconnect L.P. Fuel Supply
R tube at engine/aircraft interface.

R (a) Engines No.1 and No.3 refer to Fig.303 item A.

R (b) Engine No.2 refer to Fig.303 item B.

R (8) Engines No.1, No.2 and No.3 with S.B.73-8105 disconnect L.P. Fuel Supply tube at engine/aircraft interface.
R Refer to Fig.304.

(a) Remove safety retaining pin (4) and slide nut cover (5) rearwards.

(b) Remove nuts and bolts (6,7) from flange.

(c) Remove heat shield (8) and allow to be retained by by retaining cord.

(9) Connect adapter to engine fuel supply tube.

C (10) Deleted.

(11) Position clean receptacle under drain outlet in gas generator turbine section lower fairing.

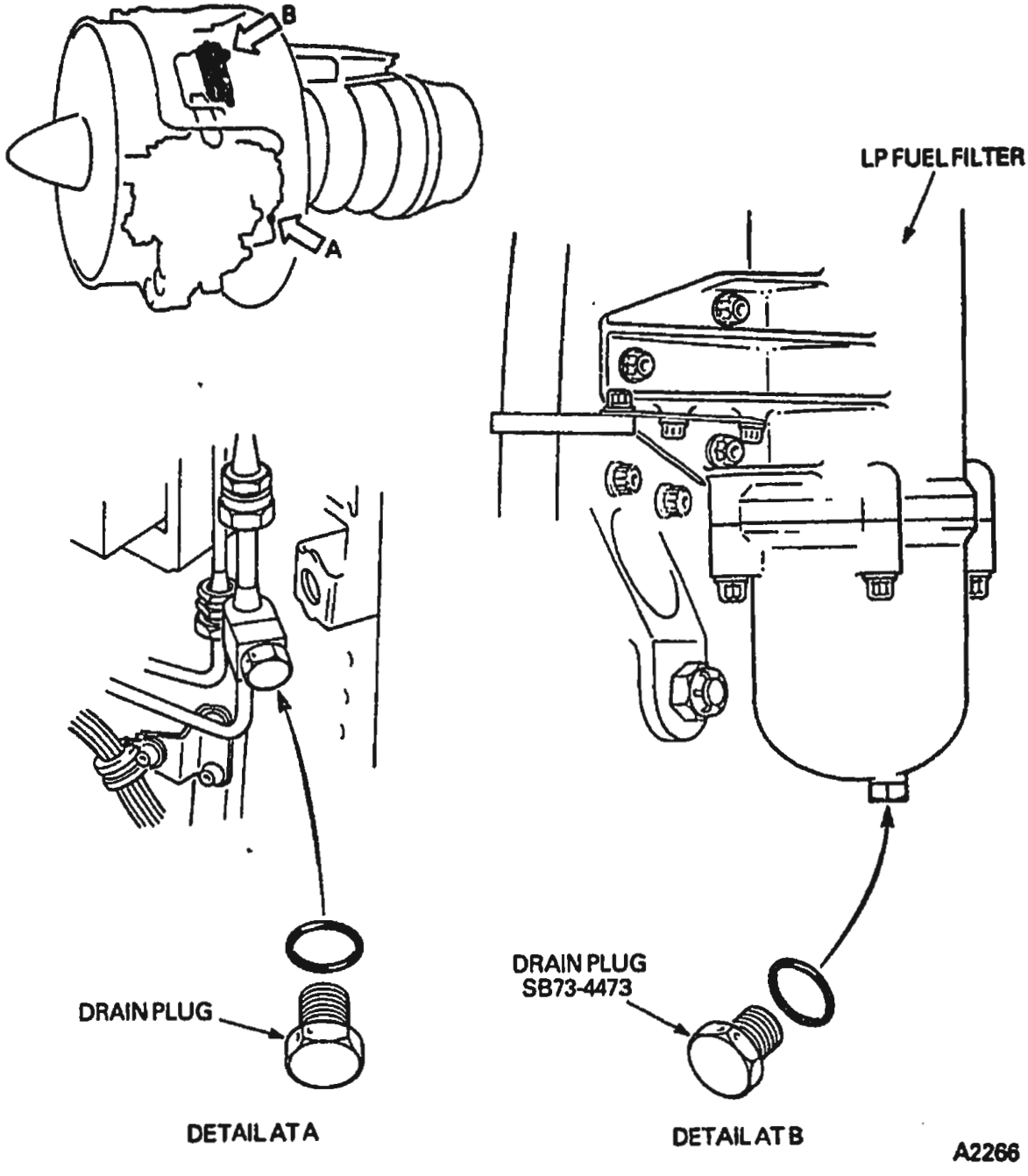
(12) Connect and engage external power system (Ref. 24-41-00).

E. Inhibit Engine Fuel System - Motoring Method

C (1) Connect supply of slushing oil TWA Stk Nbr 50-0842
C to inlet of fuel pump then open shut-off valve (13).

(2) On engines with S.B.73-4473, when fuel free inhibiting fluid flows from L.P. filter drain, fit and secure drain plug and wirelock.

(3) Select FUEL AND IGNITION switch, zone 215, ON.



R
R

Fuel system drain points
Fig.301

EFFECTIVITY: ALL

(4) Motor engine (Ref. 71-00-00) and move FUEL AND IGNITION switch to ENRICH position and hold.

(5) When fuel free inhibiting fluid flows from turbine section drain move FUEL AND IGNITION switch to OFF position. Continue to motor engine for a further 5 seconds then cancel motoring cycle (Ref. 71-00-00) and close rig shut-off valve (13).

C CAUTION : OBSERVE STARTER DUTY CYCLE

F. Inhibit Engine Fuel System - Hand Turning Method

(1) Prepare engine H.P. system for hand turning (Ref. 72-00-00).

(2) Ensure relevant circuit breakers are open to isolate electrical supply to ignition system.

C (3) Connect supply of slushing oil TWA Stk Nbr 50-0842
C to inlet of fuel pump then open shut-off valve.

(4) On engines with S.B.73-4473, when fuel free inhibiting fluid flows from L.P. filter drain, fit and secure drain plug and wirelock.

(5) Move FUEL AND IGNITION switch to ENRICH position and hold.

(6) Turn engine H.P. compressor system, using hand turning tool until fuel free inhibiting fluid flows from turbine section drain.

(7) Move FUEL AND IGNITION SWITCH to OFF and continue hand turning and inhibiting for a further 30 seconds then
C close supply of slushing oil.

(8) Remove hand turning tool (Ref. 72-00-00).

G. Inhibit Engine Fuel System - Engine Unturnable

(1) Proceed as detailed in F.(2) through (8) disregarding references to hand turning engine H.P. compressor system.

C H. Disconnect oil supply

(1) Refer to fig.303 disconnect hose from adapter.

(2) Remove adapter from engine fuel supply tube.

(3) Engines No.1, No.2 and No.3 without S.B.73.8105.

(a) Fit and lubricate (Ref. 70-02-01) new seal ring to engine fuel supply tube then connect and secure supply tube at engine/aircraft interface. Torque tighten bolts and nuts to between 80 and 100 lb. in.

R (4) Engine NO.1, No.2 and No.3 with S.B.73-8105 refer to Fig.304 fit fuel tube and heat shield assembly (8).

R (a) Fit and lubricate a new seal (9).

(b) Fit flange nuts and bolts (6,7) torque tighten to 80 to 100 lb.ins.

(c) Prepare surface of heat shield (8) and nut cover assembly (5) to T.S.D.594 O.P.707.

(d) Position nut cover assembly (5) and bond to heat shield assembly (8) using SILCOSET 152 bond to T.S.D.594 O.P.707.

R (e) Put the safety retaining pin (4) through the holes
R in the spigots that protrude through the nut cover
R assembly (5). Fasten the pin.

(f) Apply a bead of bonding agent and bond safety pin at cover.

(5) Close left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref.71-11-00) or 433AL for engine No.2 (Ref. 71-12-01).

(6) Close circuit breakers opened in operation D. (2).

(7) De-energize external power system (Ref.24-41-00).

C I. Fuel System Depreservation

C (1) Open relevent circuit breaker to isolate electrical
C supply to ignition system.

C (2) Motor engine and move fuel and ignition switch to
C ENRICHMENT position and hold.

C (3) When fuel free of inhibiting fluid flows from
C turbine drain move fuel and ignition switch to off
C position. Continue to motor engine for a further
C 5 seconds then cancel motoring cycle.

C CAUTION : OBSERVE STARTER DUTY CYCLE.

C (4) Remove preservation tags and make proper entry in
C engine records.

FIGURE DELETED

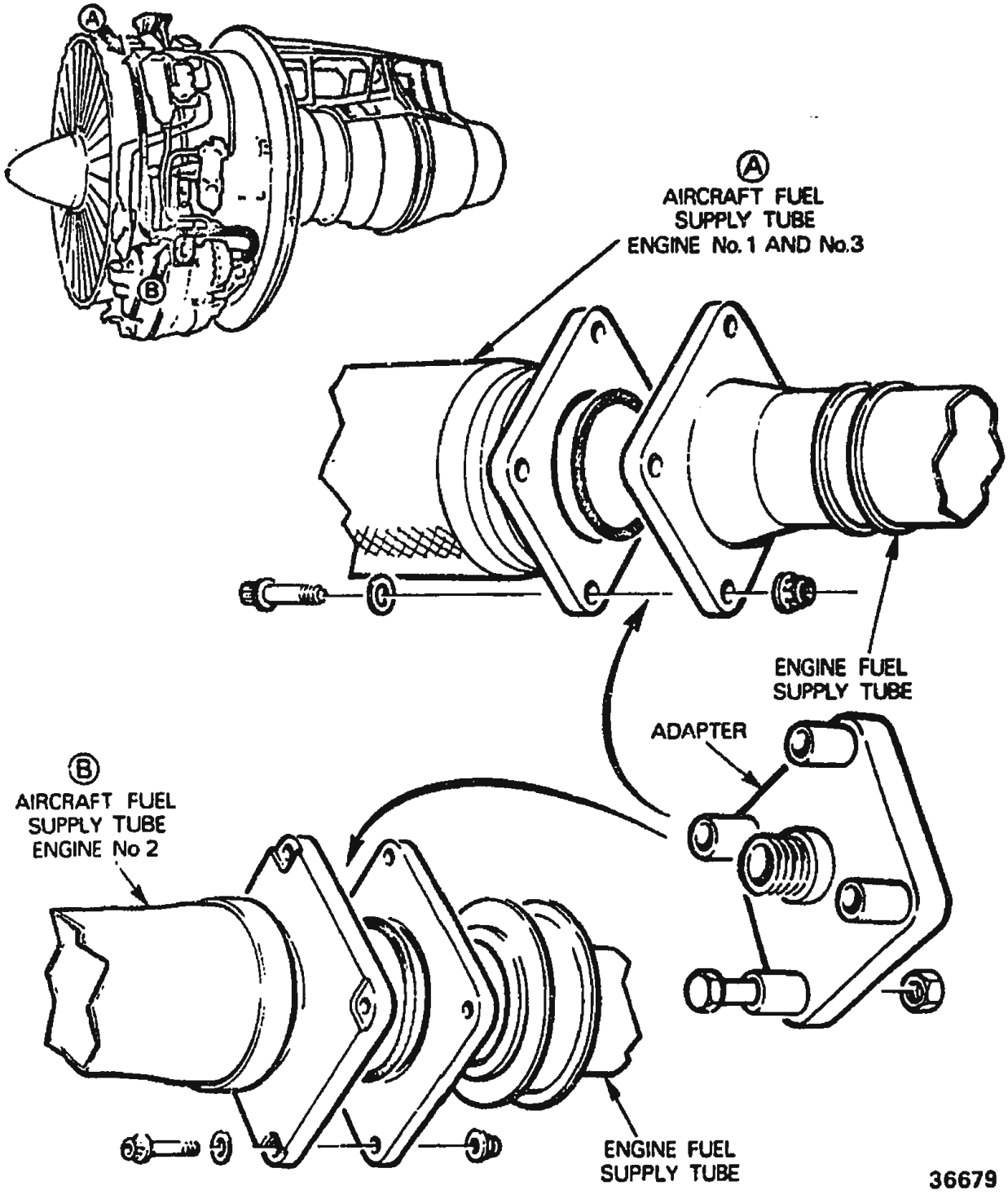
C
C

Inhibiting rig
Fig.302

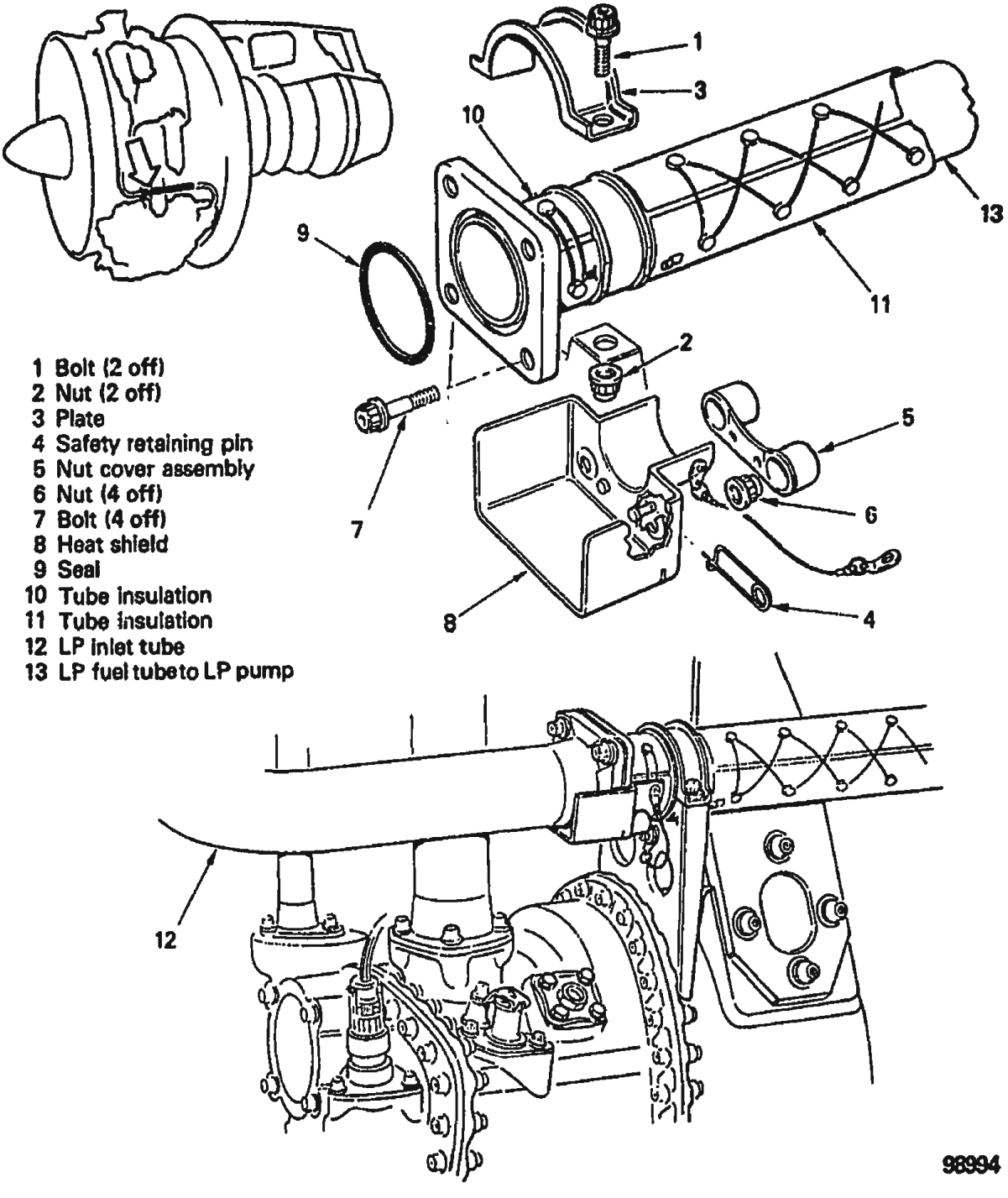
R
R
050B

EFFECTIVITY: ALL

1A



Fuel system disconnect points
Fig.303



Fuel system disconnect points engines with S.B.73-8105
Fig.304

ENGINE FUEL AND CONTROL - ADJUSTMENT/TEST

1. Test L.P. Fuel System Units and Tubes for Leaks

   A. Open left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00, Servicing) or 433AL and DL for engine No.2 (Ref. 71-12-01 and 05, Servicing).

   B. Energize ground service system (Ref. 24-41-00).

   C. Select relevant ENG TANK VALVE switchlight open, zone 215.

   D. Select both relevant TANK PUMP switchlights on, zone 215.

   E. Examine appropriate unit and/or tubes for leaks.

   F. Select TANK PUMP switchlights off.

   G. Select ENG TANK VALVE switchlight closed.

   H. De-energize ground service system.

   J. Close left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00, Servicing) or 433AL and DL for engine No.2 (Ref. 71-12-01 and 05, Servicing).

ENGINE FUEL AND CONTROL - INSPECTION/CHECK

1. Check Fuel for Contamination

Service Bulletin referred to

S.B.73-4473 - Fuel Filter Drain Valve replaced by Drain Plug.

A. Equipment required:

Clean transparent receptacle - minimum capacity:

1 U.S. pint
1 Imperial pint
0.5 Litres

Stainless steel locking wire: British gauge - 22 S.W.G.
American gauge - 21 A.W.G.

B. Connect and energize external power system (Ref. 24-41-00).

C. Open left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00, Servicing) or 433AL for engine No.2 (Ref. 71-12-01, Servicing).

D. Select relevant ENG TANK VALVE open, and TANK PUMP on.

R E. Engines with S.B.73-4473

(1) Refer to fig.601, position receptacle under drain plug.

(2) Remove drain plug.

(3) When fuel sample has been obtained, fit and lubricate (70-02-01) new seal ring to drain plug then fit and secure drain plug and wirelock.

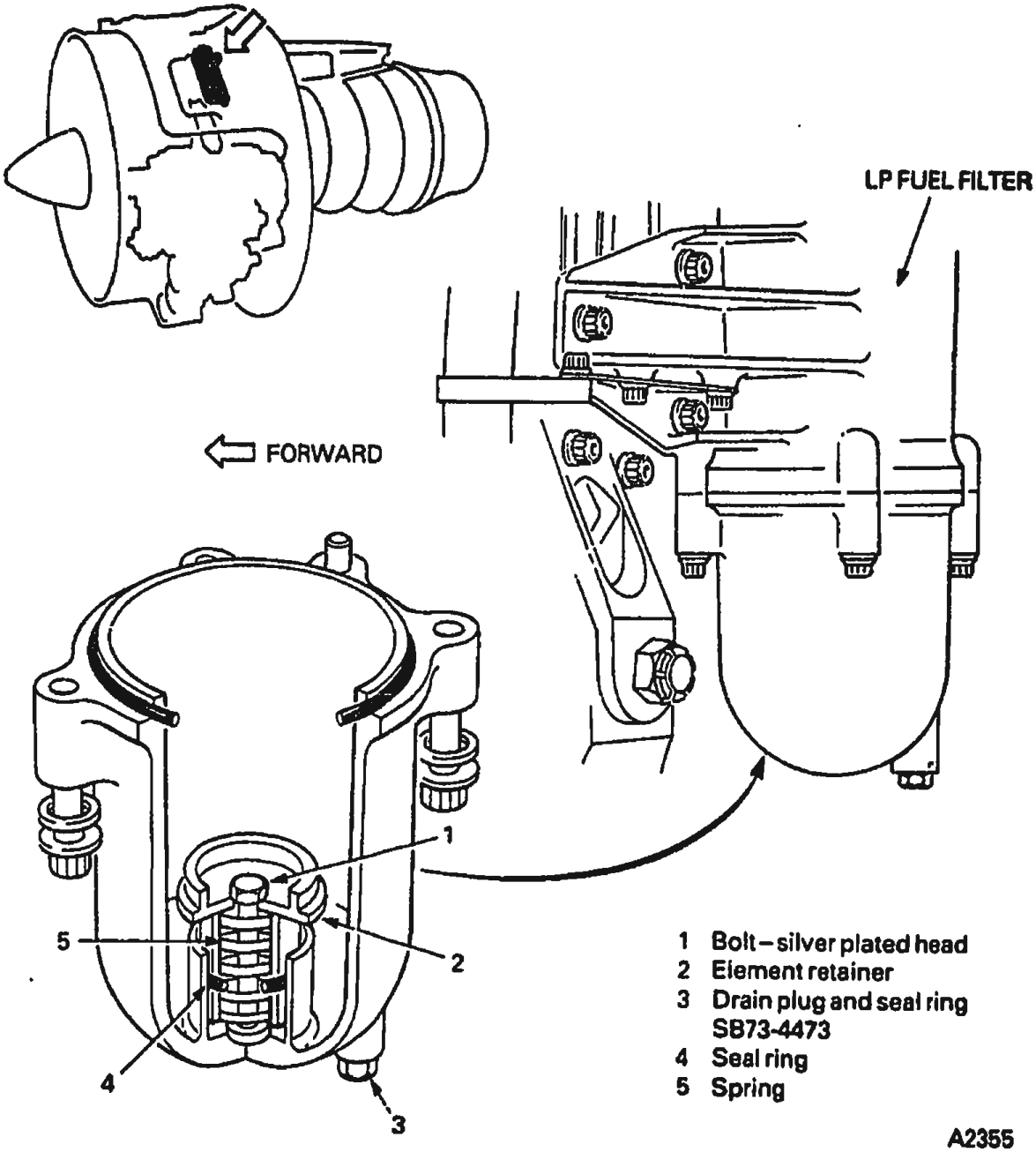
R F. Select TANK PUMP off and ENG TANK VALVE closed.

R G. De-energize external power system (Ref. 24-41-00).

R H. Examine fuel sample for contamination (Ref. 70-01-06).

R J. If sample reveals free water, or is contaminated, remove L.P. filter element (Ref. 73-11-02) and follow the procedure detailed in 70-01-06.

R K. Close left-hand hinged cowl, 413A or 423A for engine No.1 and 3 (Ref. 71-11-00, Servicing) or 433AL for engine No.2 (Ref. 71-12-01, Servicing).



R Fuel system inspection/check
R Fig.601

FUEL SUPPLY SYSTEM - DESCRIPTION AND OPERATION

1. General

Fuel from the aircraft supply system is delivered by an L.P. pump, through an oil cooler, P4 air cooler, fuel flow transmitter and a fuel filter, to an H.P. pump. The H.P. pump delivers the fuel, through a fuel flow regulator,
R starting fuel flow regulator, H.P. shut-off valve , H.P. fuel filter and a manifold to the fuel spray nozzles.

Some of the above units are not basically distribution units but have been included in this section to complete the flow sequence. These units are listed below and are described in the Chapter/Section indicated:

Fuel Cooled Oil Cooler	72-01-00
Fuel Flow Transmitter	73-34-00
Fuel Flow Regulator	73-21-00
Starting Fuel Flow Regulator	73-21-00
Fuel Enrichment Solenoid	73-21-00

Fig.3 illustrates the location of the system units and tubes on the engine, fig.2 the general arrangement of the system and fig.1 the spray nozzles and manifold.

Service Bulletins referred to:

R S.B.73-2222 Introduction of P4 type spray nozzle in No.6 position.

2. Description

A. Combined Fuel Pump Assembly

The fuel pump assembly, which comprises the L.P. pump, H.P. pump and the H.P. fuel control valves and restrictors, is located in zones 412, 422 and 432 on the rear face of the high-speed external gearbox from which the drive for the pumps is taken.

L.P. Fuel Pump

The L.P. pump consists of a single-stage centrifugal, scroll-type impeller mounted on a shaft which is supported in a case incorporating an inlet and an outlet port. The drive to the pump is transmitted, through a quillshaft, from the H.P. pump drive gear.

H.P. Fuel Pump

The H.P. pump consists of two meshing spur gears supported in a case incorporating an inlet and an outlet port. The drive from the external gearbox is transmitted to one of the spur gears through a drive coupling and quillshaft. This gear also incorporates internal splines which engage with the L.P. pump quillshaft. To prevent fuel (used internally to lubricate the bearing surfaces and splines) from entering the external gearbox in the event of a seal failure, the drive coupling area is connected by an external tube to the fuel drains collector tank (Ref.71-70-00).

H.P. Fuel Control Valves and Restrictors

The fuel pump assembly also contains a H.P. full-flow relief valve, a trim valve, a pressure drop spill valve, a fixed and a variable restrictor and an electric actuator as illustrated in 73-21-00, fig.3.

The full-flow relief valve consists of a spring loaded valve that senses H.P. delivery fuel pressure. If the H.P. delivery pressure exceeds a predetermined value the valve opens and allows fuel to return to the H.P. pump inlet.

R The fixed restrictor, variable restrictor, electric
R actuator and the trim valve in conjunction with the fuel
R control signal amplifier form the engine maximum N2 or N2 and T.G.T. limiting system.

The variable restrictor consists of a valve that is rotated, in a ported sleeve, by the electric actuator. H.P. pump outlet fuel is passed through the restrictor and the pressure drop created is used, with the pressure drop across the fixed restrictor, to control the position of the trim valve. Stops, incorporated in the drive between the actuator and the rotary valve, limit the amount of fuel trim that can be applied so preventing engine flame out due to fuel starvation should a malfunction occur in the amplifier. Also, to prevent maximum fuel trim being maintained should the actuator power supply fail in this position, the rotary valve is loaded by a spring which will gradually rotate the valve to the no trim position.

The actuator comprises a combined two phase induction type a.c. motor and tachogenerator housed in a case that is mounted in the pump assembly. Electrical connections to the motor stators and the tachogenerator are made through a terminal block, secured to the actuator case, and a connector secured to the pump assembly case. A gearbox, secured to the actuator case, transmits the drive between the motor and the variable restrictor.

The reference stator windings of the motor are energized by a 115V. 400 Hz. aircraft supply which is phase changed by 90 degrees. The control stator windings are energized by the control signal amplifier output stage with a 115V. 400 Hz. supply which either leads or lags the reference winding voltage by 90 degrees, to turn the motor rotor and drive the variable restrictor to the required position.

When the rotor turns to rotate the variable restrictor it also rotates the tachogenerator. This induces a voltage in the tachogenerator output windings proportional to the motor rotor speed. The voltage is fed back to the amplifier output stage where it is evaluated to provide optimum response with system stability.

The trim valve is fitted in the H.P. fuel delivery passage to the fuel flow regulator. The valve consists of a fixed metering sleeve which incorporates metering ports and a rotating metering plunger that moves inside the sleeve. The plunger which is spring-loaded in the open position, senses the pressure drop created by the fixed and variable restrictors. If this pressure drop exceeds a predetermined value, the plunger moves to reduce fuel flow through the sleeve ports, thus reducing flow to the fuel flow regulator. Simultaneously this disturbs the pressure drop sensed by the spill valve which moves to increase fuel spill. A fuel by-pass around the trim valve permits sufficient fuel flow to prevent 'flame out', due to fuel starvation, should full trim be applied at high altitude.

The pressure drop spill valve consists of a spring loaded piston that senses the fuel pressure drop across the fuel flow regulator. Should the pressure drop increase, the piston moves to allow H.P. delivery fuel to return to the H.P. pump inlet. A decrease in pressure drop results in the piston moving to decrease fuel spill. In this way the spill valve schedules H.P. delivery fuel consistent with the fuel flow regulator requirement.

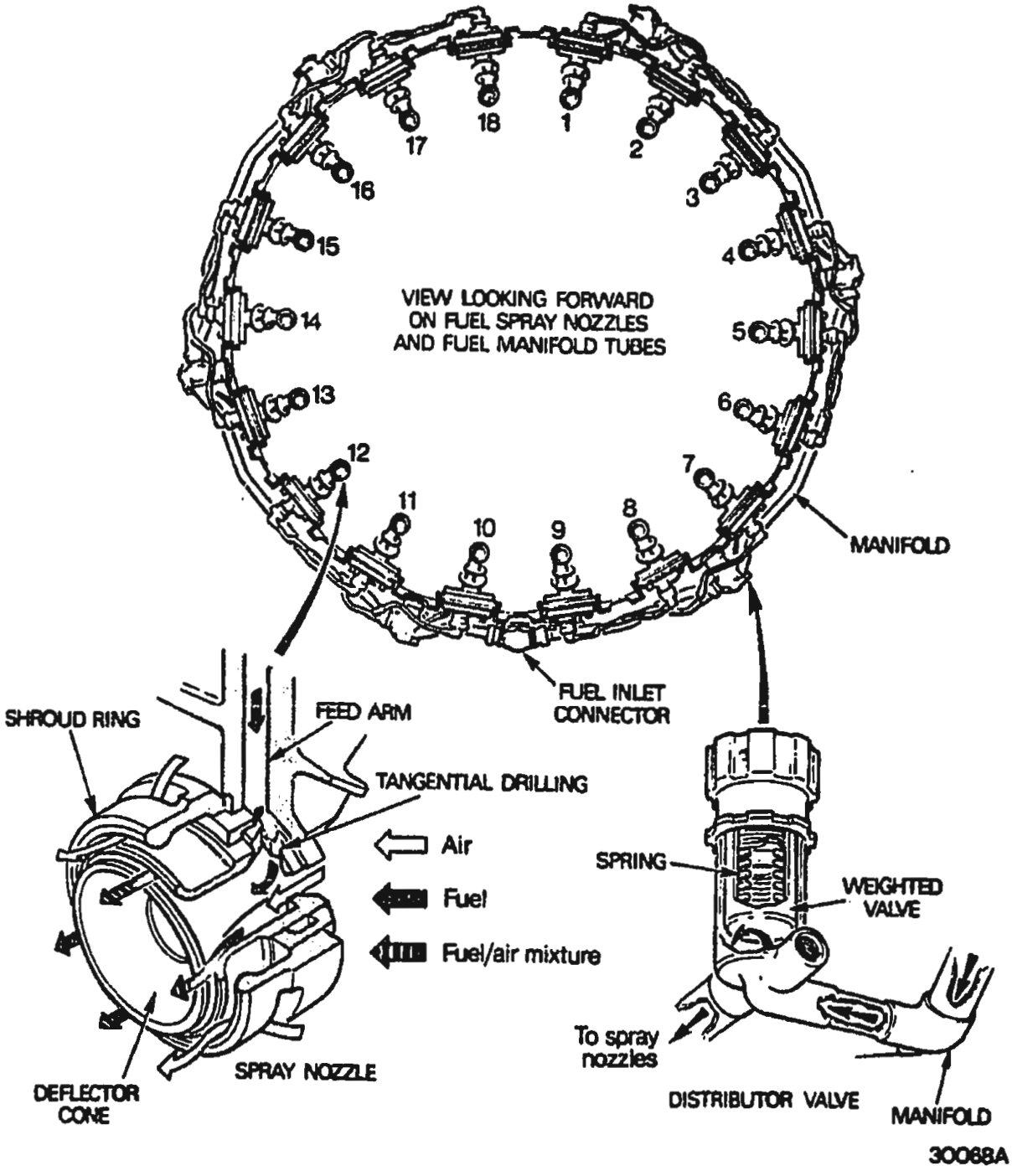
B. Fuel Cooled Oil Cooler

The fuel cooled oil cooler is located in zones 412, 422 and 432 on the left-hand side of the L.P. compressor case. The unit performs a dual function of oil cooling and fuel heating as described in 72-01-00.

C. Fuel Cooled P4 Air Cooler

The P4 air cooler is located in zones 412, 422 and 432, and secured to brackets mounted on the L.P. compressor case.

The cooler (Ref. fig.2) which reduces the temperature of P4 air supplied to the fuel flow regulator and the P4/PF switch (Ref.73-21-00) consists of three concentric tubes.



Fuel manifold, distributor valves
and spray nozzles
Fig.1

L.P. fuel flows through the centre tube in a single pass and absorbs heat from P4 air flowing in the space between the centre tube and inner tube. PF air is directed into the space between the inner tube and outer tube to insulate the engine Zone 1 (Ref.75-21-00) from the hot P4 air.

P4 air, tapped from No.15 and 17 spray nozzles, is fed into the space between the centre tube and the inner tube. The air flows through the cooler and is then directed through a Tee piece to the fuel flow regulator and the P4/PF switch.

PF air, tapped from the L.P. compressor duct, enters the space between the inner tube and outer tube through a small duct surrounding the P4 inlet tube. Some of this air is also supplied to the P4/PF switch.

D. Fuel Flow Transmitter

R The fuel flow transmitter is located in zones 412, 422 and 432 in L.P. system between the fuel cooled P4 air cooler and the fuel filter. .Signals from the unit are used to provide flight station indication of fuel consumed and rate of fuel flow (Ref.73-34-00).

E. Fuel Filter

C The fuel filter is located in zones 412, 422 and 432 on the left-hand side of the L.P. compressor case and consists of an expendable filter element in a cylindrical case. The case has a detachable end cover which incorporates a drain plug and a spring loaded element retainer. The retainer applies a loading on the element to ensure that it seats positively on the filter seals, thus preventing fuel leakage across the element end faces. The retainer assembly is secured to the end cover by a bolt featuring a silver plated head, the degree of discolouration of which provides an indication of the amount of corrosive properties in the fuel. Two pressure switches and a temperature bulb are mounted on the filter case. The pressure switches are described in 73-31-00 and the temperature bulb is described in 73-37-00. Fuel entering the filter housing flows inwards through the filter element and passes to the outlet port. A by-pass valve, positioned between the inlet and outlet ports, maintains fuel flow in the event of the element becoming restricted.

F. Fuel Flow Regulator

The unit is located in zone 412, 422 and 432 on the rear face of the external gearbox. Although it is basically a controlling unit it is also used to divide the main and primary fuel supplies of the system. A description of the fuel flow regulator is given in 73-21-00.

G. H.P. Fuel Differential Pressure Transducer

The transducer is located in zones 412, 422 and 432 on the lower front face of the engine firewall. The unit senses the fuel pressure drop across the fuel flow regulator through two tubes that connect to tappings on the regulator case and the fuel outlet elbow. A description of the transducer is given in 73-38-00.

H. Starting Fuel Flow Regulator

The starting fuel flow regulator is located in zones 412, 422 and 432 on the left-hand side of the L.P. compressor case. The unit is basically a controlling unit and is described in 73-21-00.

J. Fuel Enrichment Solenoid

The fuel enrichment solenoid is secured to the H.P. fuel shut-off valve in zones 412, 422 and 432. The unit is basically a controlling unit and is described in 73-21-00.

K. H.P. Fuel Shut-off Valve

The H.P. shut-off valve is located in zones 412, 422 and 432 on the rear left-hand side of the L.P. compressor case and is interposed in the H.P. fuel system between the controlling units and the fuel manifold. It enables the fuel supply to the spray nozzles to be controlled from the flight station to effect engine starting and stopping. The fuel supply from the fuel flow regulator is connected to the unit which, dependent on the position selected on the flight station fuel and ignition switch, directs the fuel either to the fuel manifold or back to the H.P. fuel pump inlet.

The shut-off valve comprises a ported case which houses a ported sleeve, a hollow plunger and a non return valve. Secured to the case is an actuator assembly comprising a d.c. motor, a reduction gear assembly and a switch mechanism. The case also houses the inlet and outlet ports for the fuel enrichment solenoid and also provides the mounting for this unit (ref. para.J.).

The plunger is positioned either 'open' or 'close' by the actuator, rotation of which is transmitted through the reduction gear, a quill shaft and a pinion shaft to a rack on one side of the plunger. The electrical supply to the actuator is controlled by the fuel and ignition switch. When selected 'ON' the switch connects a 28 volt d.c. supply to the opening circuit and the actuator rotates to position the plunger and permit fuel flow through the unit to the spray nozzles. On reaching the fully open position the electrical supply is cancelled by the switch mechanism. Conversely when the fuel and ignition switch is selected 'OFF' a 28 volt d.c. supply is connected to the closing circuit. This supply is cancelled by the switch mechanism when the valve reaches the fully closed position.

In this position the plunger directs the fuel flow back to the H.P. pump inlet and simultaneously connects the dump return from the spray nozzles to the drains collector tank (Ref.71-70-00).

An indicator on the valve body provides visual indication of the valve position.

L. Fuel Tubes

Rigid tubes are used throughout the fuel system. The interconnection of units is illustrated in fig.2 and positions of the tubes around the engine in fig.3.

R M. H.P. Fuel Filter Assembly

The H.P. fuel filter assembly is positioned in the main fuel supply to the fuel manifold and located at the lower centre of the combustion case immediately adjacent to the fuel manifold.

The filter assembly comprises a case, incorporating an inlet, and outlet connector and a filter element. The element is secured within the case by a bolt, the fuel flowing inwards through the element, to the outlet connection.

N. Fuel Manifold

The fuel manifold, (Ref.fig.1), consists of two tubes which are connected together at one end to form a manifold around the combustion section outer case. Incorporated in the manifold are six distributor valves, each of which feed three spray nozzles.

Each distributor valve consists of a case in which a weighted valve and a spring are fitted as illustrated in fig.1. The weighted valves, depending on their position around the manifold, either oppose or assist fuel pressure in overcoming the spring pressure. This variation of the resistance that the fuel has to overcome compensates for the differences in pressure around the manifold and ensures fuel pressure at each spray nozzle is approximately equal.

A tapping on the manifold between No.10 and 11 spray nozzles connects with the engine drains system (Ref.71-70-00).

P. Spray Nozzles

Eighteen spray nozzles of the air spray type are fitted in location bores positioned around the combustion section outer case (Ref. fig.1) in zones 412, 422 and 432. The spray nozzles protrude into the area forward of the combustion chamber and locate in mini-flares positioned around the forward end of the front combustion liner. A seal assembly is fitted in each location bore to prevent air leakage past the spray nozzles.

Each spray nozzle comprises a feed arm, which incorporates an integral mounting flange, and a head in which a deflector cone is supported. Internal drillings direct fuel through the feed arm to an annulus formed in the head and then to a swirl chamber formed between the inner surface of the head and the deflector cone. The fuel is injected into the swirl chamber through tangential drillings, which impart a swirling motion to it, and mixes with H.P. compressor air entering the combustion chamber through the swirl chamber.

The flanges of spray nozzles 3, 15 and 17 incorporate an orifice into which a tube, attached to the seal assembly, locates. P4 air is tapped through the tube and directed to the fuel cooled P4 air cooler and also to the I.P. compressor control system (Ref. 75-31-00). On engines incorporating S.B.73-2222 - Introduction of P4 type spray nozzle at No.6 position - Provision is made to supply P4 air to the H.P. bleed valve control system.

Two of the spray nozzles in No.8 and 12 positions, also incorporate a boss into which an igniter plug is fitted.

3. Operation

The L.P. fuel pump receives fuel from the aircraft supply system and delivers it to the H.P. fuel pump at a pressure sufficient to ensure satisfactory H.P. pump performance at all operating conditions.

From the L.P. pump outlet the fuel flows through the fuel cooled oil cooler where, at low fuel temperatures, uncooled oil is directed through the cooler to allow heat to be transferred to the fuel, thereby achieving fuel heating and oil cooling (Ref.72-01-00).

The fuel then flows through the P4 air cooler, where it cools the P4 air supplied to the pressure ratio control of the fuel flow regulator, and then through the fuel flow transmitter and fuel filter to the H.P. pump.

Fuel entering the H.P. fuel pump is delivered to the H.P. side of the system at a pressure directly proportional to the speed at which the pump is driven, the delivery flow being controlled by the control valves as described in 73-21-00.

As the fuel passes through the fuel flow regulator it is divided into primary and main fuel supplies. The primary fuel supply is directed through the starting fuel flow regulator and then to the fuel pump assembly where it is connected into the spill valve supply from the fuel flow regulator. The main fuel supply flows through an outlet elbow and is directed to the H.P. shut-off valve.

The H.P. shut-off valve, when selected to the 'open' position, directs the fuel to the fuel manifold and, when selected 'close', directs the fuel back to the inlet side of the H.P. pump. Also when closed the shut-off valve connects the fuel return line from the fuel manifold to the fuel drains collector tank (Ref.71-70-00).

R On leaving the shut-off valve the fuel supply flows through a supply tube and the H.P. fuel filter and fuel manifold to the distributor valves.

From the distributor valves the fuel is directed through the feed arms to the annulus incorporated in each spray nozzle head. The fuel flows out of the annulus through tangential drillings, which impart a swirling motion to it, and mixes with the air stream at the entry to the combustion chamber.

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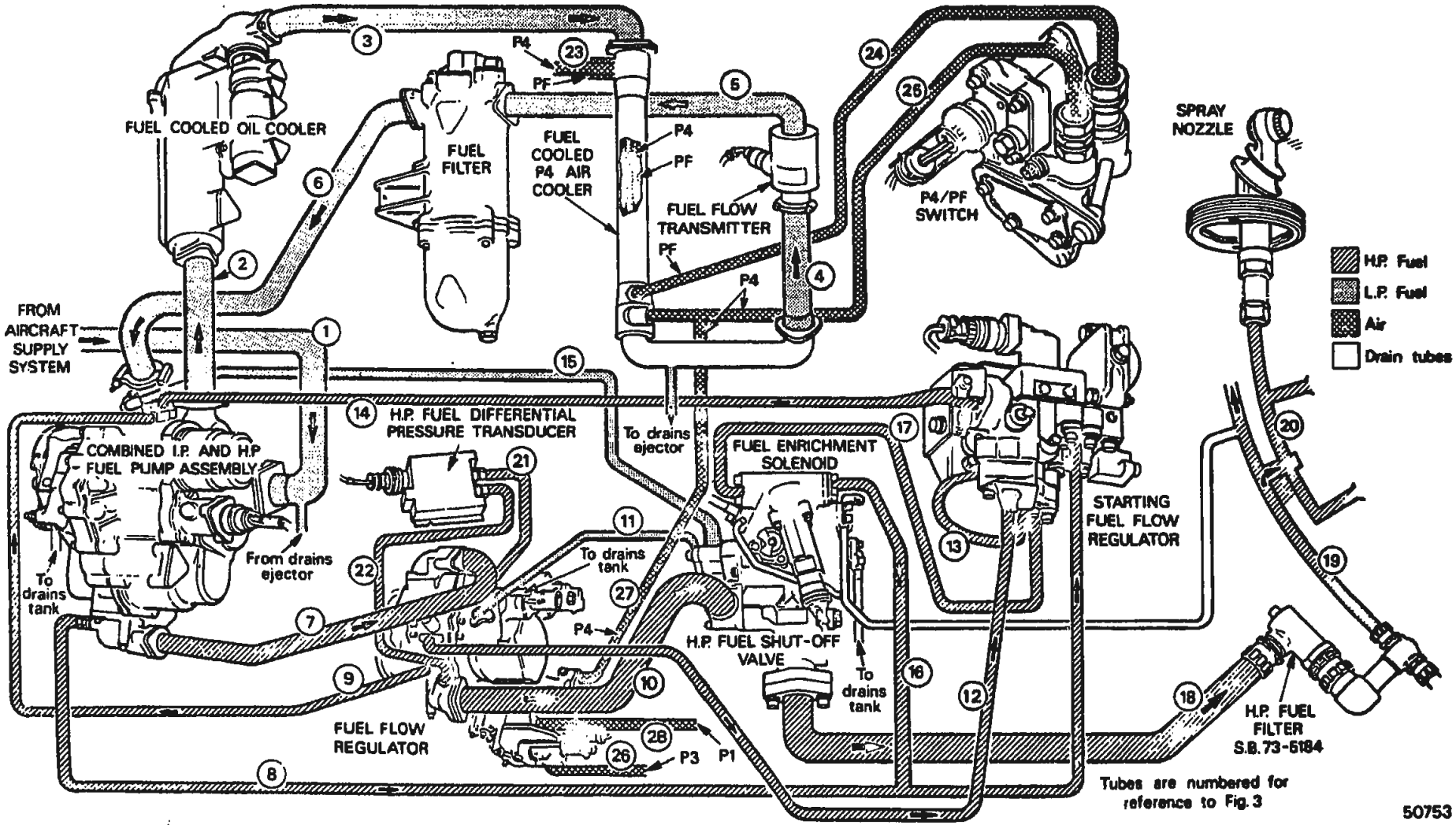
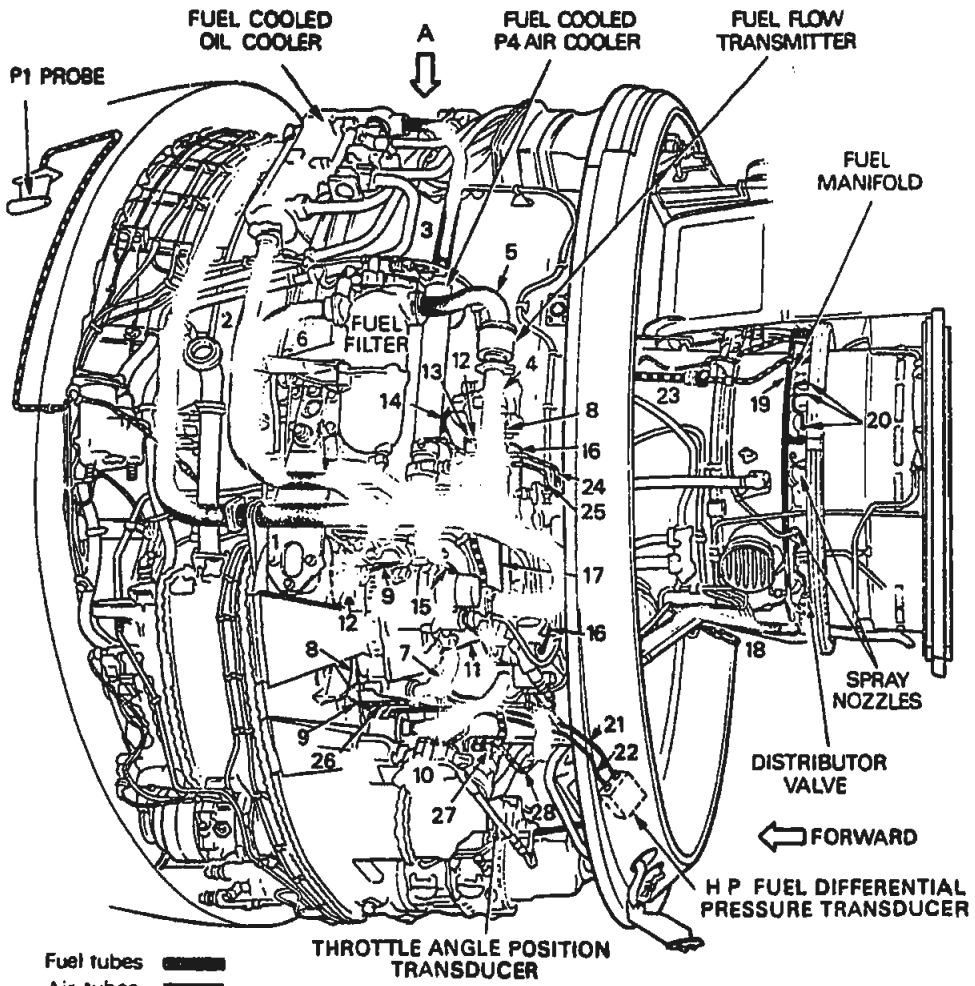
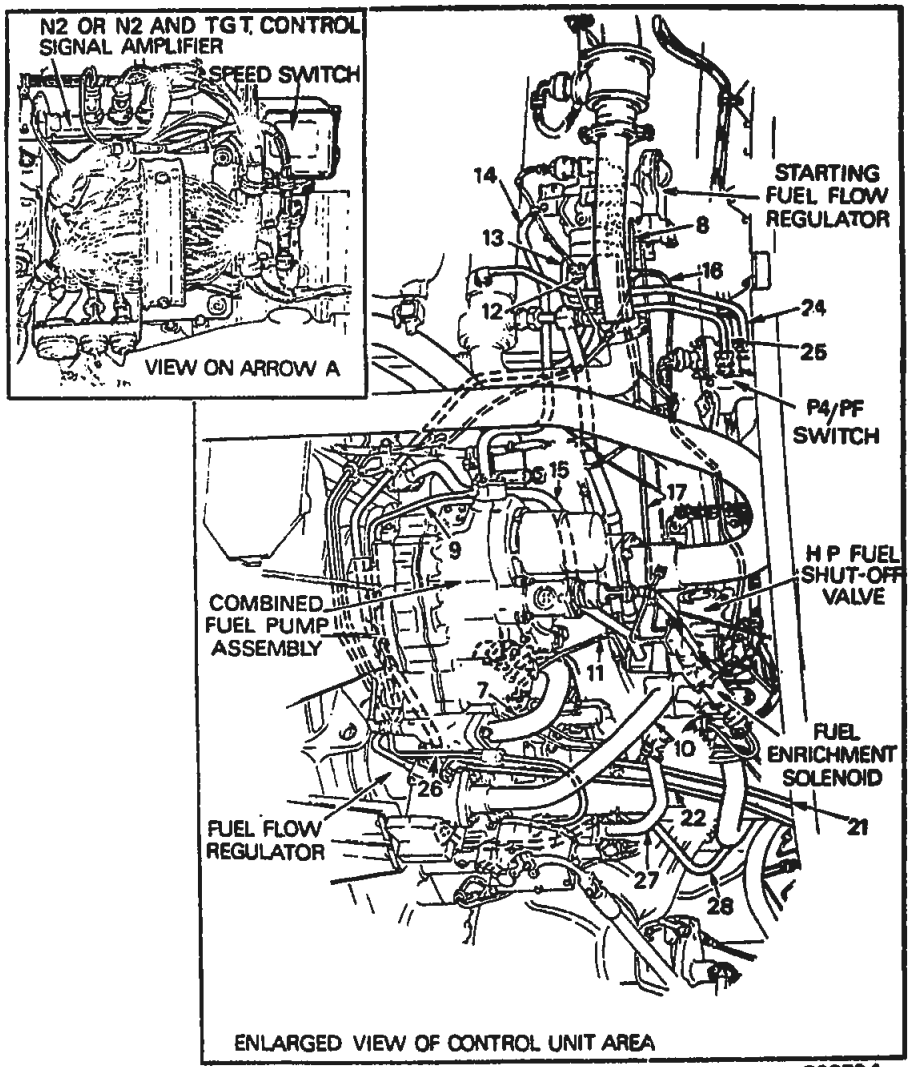


Fuel system general arrangement
Fig.2

EFFECTIVITY: ALL




N2 OR N2 AND TGT CONTROL SIGNAL AMPLIFIER
SPEED SWITCH
VIEW ON ARROW A
STARTING FUEL FLOW REGULATOR
P4/PF SWITCH
H P FUEL SHUT-OFF VALVE
COMBINED FUEL PUMP ASSEMBLY
FUEL ENRICHMENT SOLENOID
FUEL FLOW REGULATOR
ENLARGED VIEW OF CONTROL UNIT AREA

30072A

R R Fuel system units and tubes
Fig.3

EFFECTIVITY: ALL

LOW PRESSURE FUEL PUMP - REMOVAL/INSTALLATION

R 1. General

R A. The L.P. fuel pump with the H.P. fuel pump form the combined fuel pump assembly. The following instructions apply to the combined pump assembly.

R B. In order to eliminate potential fuel system instability
R Lucas Service Bulletins PAC101-73-24 (CP.4771), PAC101-73-33
R (CP.4779) and PAC101-73-58 (CP.5230) introduce a damping
R orifice bobbin into the fuel pump spill valve inlet bore. A
R visual inspection of the spill valve inlet bore is required
R during installation of the fuel pump, to confirm incorporation
R of the damping orifice bobbin.

2. Removal/Installation Combined Fuel Pump Assembly

R Service Bulletins referred to:

R	LUCAS S.B. PAC101-73-24	FUEL AND CONTROL - H.P. and L.P. fuel pumps - Introduction of a spill valve damping orifice into H.P. fuel pump servo connection Mod.CP.4771
R	LUCAS S.B. PAC101-73-33	FUEL AND CONTROL - Pump and Control - Introduction of re-designed trim valve and new spill valve orifice bobbin Mod.CP.4779
R	LUCAS S.B. PAC101-73-58	FUEL AND CONTROL - H.P. and L.P. fuel pumps - Revised actuator valve sleeve/metering slots and spill valve damping orifice Mod.CP.5230
	LUCAS S.B. PAC101-73-25	(CP.4544) - Introduction of new support bracket.
	73-2232	Self consuming drains.
	72-2564	Support brackets from gearbox flange to fuel pump and fuel flow regulator.
	72-3878	Introduction of thickened front and rear H.S. gearbox housings (Deletion of fuel pump support bracket).
	73-4404	Revised L.P. fuel return tube from S.O.V. to H.P. fuel pump.
	73-8105	Fuel system L.P. inlet pipe - Addition of flange heat shield and pipe insulation.

Referenced Procedures:

70-02-01	Identification, Lubrication and Fitting of Rubber Sealing Rings
70-12-02	Fitting Vee Band Coupling Clamps
70-51-00	Torque Tightening Techniques
71-11-00	Cowlings, Engines No.1 and No.3 - Servicing
71-12-01	L.H. and R.H. Lower Hinged Cowl - Servicing
73-00-00	Engine Fuel and Control - Servicing
73-00-00	Engine Fuel and Control - Adjustment/Test
73-11-01	Low Pressure Fuel Pump Adjustment/Test
73-11-09	Fuel Tubes - Maintenance Practices

Illustrated Parts Catalogue References:

The I.P.C. sections where parts disturbed during the following operations can be located are as follows:

	73-11-01	L.P. and H.P. Fuel Pump Installation
	73-11-09	Fuel System, H.P. Fuel Tubes
R	73-11-07	Fuel System, L.P. Fuel Tubes

CAUTION: THE COMBINED FUEL PUMP ASSEMBLY WEIGHS APPROXIMATELY 78 LB. (35 KG).

A. Remove Combined Fuel Pump Assembly

(1) Equipment required:

CP.20968/3 - Beam sling
Clean receptacle - minimum capacity

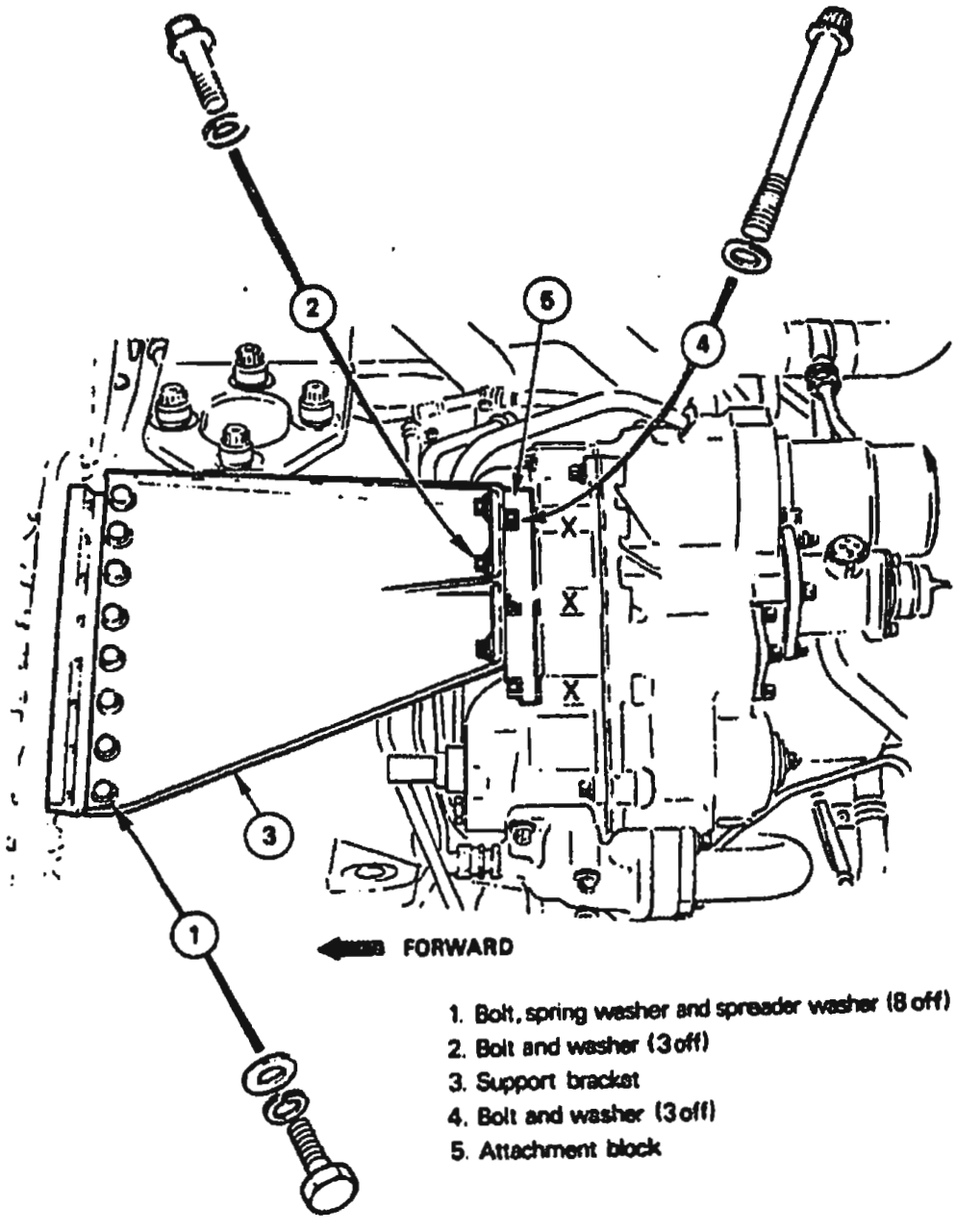
5 U.S. gallons
4 Imperial gallons
18 Litres

Flexible hose: approximate length - 72in.(1800 mm.)
internal diameter - 0.5in.(12 mm.)

(2) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag appropriate FUEL CONT AMP circuit breaker.

(3) On pilots centre console, zone 210, place appropriate Fuel Control Amplifier Test Switch in OFF position.

(4) On pilots overhead control panel, zone 210, pull appropriate Fire Emergency Shut-off Control.



1. Bolt, spring washer and spreader washer (8 off)
2. Bolt and washer (3 off)
3. Support bracket
4. Bolt and washer (3 off)
5. Attachment block

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Fuel pump assembly support bracket disconnect points
Fig.401

(5) Open L.H. hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL for engine No.2 (Ref. 71-12-01).

(6) Drain L.P. fuel system (Ref. 73-00-00, Servicing).

(7) On engines incorporating S.B.72-2564, refer to fig.401, remove bolts, spring washers and spreader washers (1), bolts and washers (2) and support bracket (3).

R (8) On engines incorporating S.B.73-2232, refer to fig.403 (Sheet 1) and disconnect connector (1).

(9) Disconnect electrical connector (2).

(10) On engines without S.B.73-8105 remove tube (3).

(11) On engines with S.B.73-8105 refer to Fig.403 (Sheet 5) remove nuts and bolts (1 and 2) plate (3) from support bracket.

(a) Break locking wire between insulation blankets (10 and 11) and bracket support.

(b) Disconnect safety retaining pin (4) and slide nut cover (5) rearwards.

(c) Remove nuts and bolts (6, 7) from flange.

(d) Remove heat shield (8) and allow to be retained by retaining cord.

(e) Remove bolts (4 off) from pipe connector at L.P. fuel pump and remove tube (13).

R (12) Refer to fig.403 (Sheet 1), disconnect connector (4).

R (13) Refer to fig.403 (Sheet 2), remove tube (5).

(14) Refer to fig.403 (Sheet 4), release tube support clips from bracket at connector (12).

(15) Refer to fig.403 (Sheet 2), release tube support clip then remove tube (6). Leave bracket attached to harness support clip.

(16) Remove tube (7).

(17) Refer to fig.403 (Sheet 3), remove tube (8).

(18) Remove tube (9), leave bracket attached to tube support clips.

Engine with S.B.73-4404, release tube support clip from electrical harness support bracket.

(19) Remove coupling clamps (Ref. 70-12-02) to disconnect connectors (10) and (11).

(20) Disconnect connector (12).

(21) Release tube support clip from tube support lug (15).

(22) Disconnect connectors at both ends of tube (15) then remove tube.

(23) Prepare for lifting.

(a) Fit and secure lifting beam to engine left-hand handling housing.

(b) Attach arm assembly to hoist at pivot nearest to arm marked PUMP END.

(c) Secure PUMP END of arm assembly to spill valve connector.

(24) Take weight of pump assembly on hoist, then remove (Ref. 70-12-02) clamp (13) withdraw unit from gearbox and lower onto a work surface.

(25) Disconnect arm assembly from pump assembly.

(26) Fit approved blanks to all exposed apertures and connectors.

(27) On engines with S.B.72-2564, refer to fig.401, remove bolts and washers (4) and attachment block (5). Retain these items for fitment to new pump assembly.

On engines with S.B.72-3878 and fuel pump assemblies with Lucas S.B.PAC101-73-25, do not remove attachment block (5) as it is part of pump assembly.

(28) Inhibit pump assembly as described in 1.B.

B. Inhibit Combined Fuel Pump Assembly

Inhibiting can be delayed for up to 48 hours providing all connectors and apertures are suitably blanked immediately following unit removal.

CAUTION: INHIBITING FLUID IS INJURIOUS TO DRIVE COUPLING SEALS. TO PREVENT CONTAMINATION FIT A LEAKPROOF BLANK TO THE H.P. PUMP DRAIN CONNECTOR BEFORE ANY INHIBITING PROCESS IS CARRIED OUT.

(1) Equipment required:

T.430085 Key
Fluid container, fitted with fine mesh filter

(2) Materials required:

	British Spec./Ref.	American Spec./Ref.	OMat Item No.
Inhibiting fluid	DTD.5578 or D.Eng.R.D. 2490	MIL-L-7870A or MIL-L-6081C ASG (grade 1010)	1029 1024A
White spirit or	B.S.245		102
R Stoddard solvent		ASTM D484-52	102A

(3) Fit blanking cap to electrical connector.

(4) Drain all fuel from unit.

(5) Fit approved covers and gaskets to all apertures.

(6) Thoroughly clean exterior of unit with white spirit or Stoddard solvent, then dry unit.

(7) Position unit with H.P. pump inlet uppermost, remove cover and gasket then pour inhibiting fluid into inlet until full.

(8) Engage key T.430085 with drive coupling, rotate coupling in an anti-clockwise direction and keep inlet topped up with inhibiting fluid until inlet remains full.

(9) Refit approved cover and gasket to H.P. pump inlet and remove key from drive coupling.

(10) Remove cover and gasket from L.P. pump inlet and outlet.

(11) Pour inhibiting fluid into L.P. pump outlet until fluid flows from L.P. pump inlet, then refit approved cover and gasket to L.P. pump inlet.

(12) Continue to pour fluid into L.P. pump outlet until completely full. During this operation allow a period of time for fluid to seep past impeller. Refit approved cover and gasket.

(13) Remove cover and gasket from connector adjacent to pressure drop spill valve then pour in inhibiting fluid until full. Refit approved cover and gasket.

(14) Clean and dry exterior of unit then check for leaks. Renew any defective gaskets topping up fluid level as required.

(15) Attach a label to unit recording date and details of inhibiting.

C. Install Combined Fuel Pump Assembly

Refer to 73-11-09 for correct procedure for fitting fuel tubes.

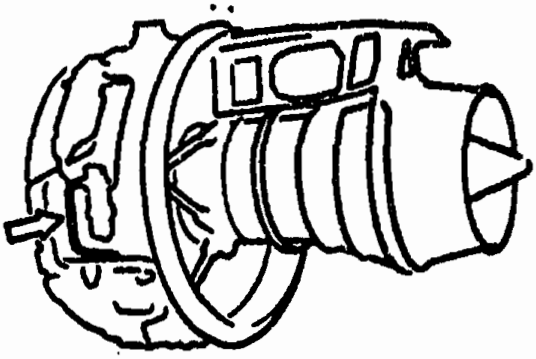
(1) Equipment required:

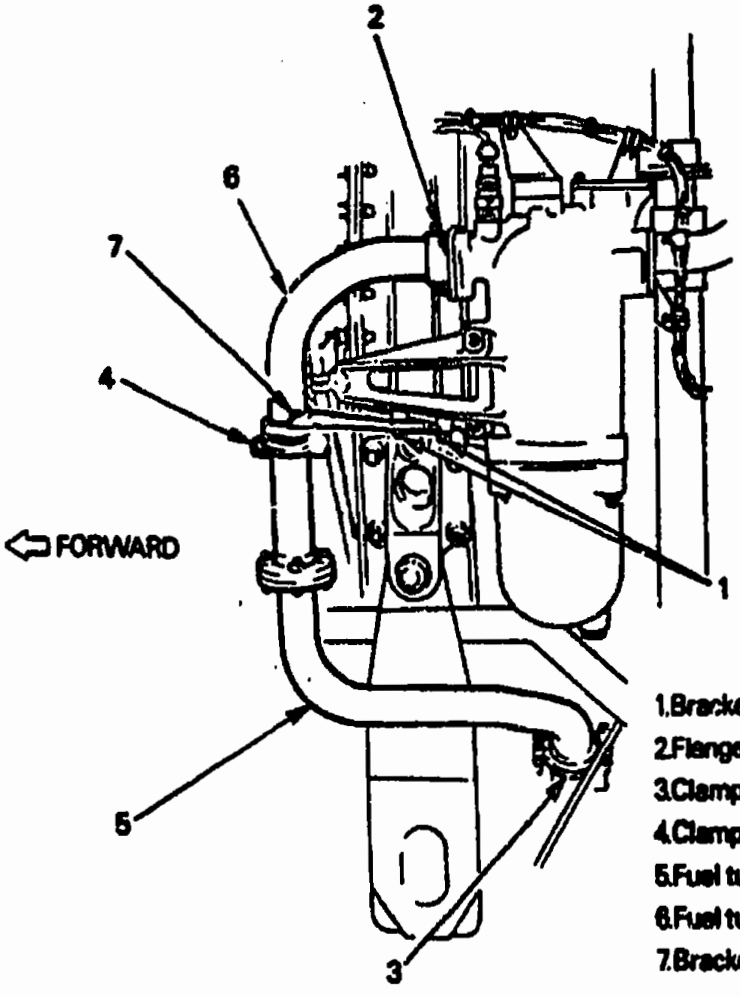
CP.20968/3 - Beam sling
Clean receptacle - minimum capacity

1 U.S. gallon
1 Imperial gallon
4 Litres

(2) Material required:

	British Spec./Ref.	American Spec./Ref.	OMat Item No.
Lockwire	DTD.189A 22 S.W.G.	 21 A.W.G.	238





1.Bracket mounting bolts(2off)
2.Flange mounting bolts(3off)
3.Clamp
4.Clamp
5.Fuel tube
6.Fuel tube
7.Bracket mounting bolts(2off)

50974

Fuel tube installation
Fig.402

(3) Ensure appropriate systems are deactivated as detailed in operations A (2) through (4).

(4) On engines incorporating S.B.72-2564 refer to fig.401, remove 3 bolts and washers at positions marked X from new pump assembly. Fit attachment block (5) to new pump and secure with bolts and washers (4).

On engines with S.B.72-3878 and fuel pump assemblies with Lucas S.B. PAC 101-73-25, attachment block (5) is part of new assembly.

(5) Remove blanks and gaskets, if fitted, from all apertures and connectors and drain off inhibiting fluid.

(6) Refer to fig.403 (Sheets 1 thru 4), ensure all mating aperture and connector faces are clean and free from damage.

(7) Fit new seal ring (16) to H.S. gearbox quillshaft then lubricate (Ref. 70-02-01).

(8) Fit and lubricate (Ref. 70-02-01) a new seal ring (14) to pump assembly drive coupling.

(9) Prepare mating flanges of connectors (10) and (11), and associated coupling clamps for fitment (Ref. 70-12-02).

(10) Prepare coupling clamp (13) and flanges of pump assembly and mounting pad for fitment (Ref. 70-12-02).

(11) Fit and lubricate (Ref. 70-02-01) new seal rings to distributor fuel connectors.

(12) Fit beam sling to engine and attach arm assembly to pump assembly as detailed in operations A. (20) (a) through (c).

(13) Lift pump assembly with hoist and fit to mounting pad on high-speed external gearbox ensuring positive location of dowel, then fit and secure (Ref. 70-12-02) coupling clamp (13).

(14) Disconnect arm assembly from pump assembly and remove beam sling from engine.

(15) Refer to fig.403 (Sheet 4) connect and secure connector (12) positioning bracket under bolt heads.

(16) Fit and secure tube (15).

(17) Fit and secure tube support clip (15) to tube support lug.

(18) Refer to fig.403 (Sheet 3), connect and secure connectors (11) and (10) with coupling clamp (Ref. 70-12-02).

C (19) Refer to fig.402, remove two bracket mounting bolts (1).

C (20) Remove fuel line, (three bolt flange), mounting bolts
C (2) at fuel filter.

C (21) Note and record amount and direction of line
C misalignment. If misalignment exceeds 1/16 inch,
C inboard, outboard, upward or downward, note and
C proceed to operation (19). If not, proceed to
C operation (25).

C (22) If misalignment is in excess of 1/16 inch, loosen
C Avica clamp nuts at (3) and (4). Do not remove
C nuts or clamps.

C (23) Reposition tubes (5) and (6) until minimum
C misalignment exists. Desired misalignment is
C less than 1/16 inch. Tubes should be properly
C positioned with only slight hand pressure. Do
C not attempt to correct for vertical misalignment
C in excess of that provided by rotation of tube (5),
C as this will require shortening of the tubes.

C (24) After tubes have been properly aligned, install
C bolts (2) at three bolt flange at fuel filter and
C tighten.

C (25) Tighten nuts in Avica clamps (3) and (4).

C (26) Install bracket mounting bolts (1). Bolts should
C start easily without preloading the bracket. If
C bracket does not align properly, loosen two mounting
C bolts (7) on tube boss. Mounting holes may be
C elongated if need be. However, as much edge
C distance as possible should be retained.

C (27) After all Avica clamp nuts are tightened and
C mounting bracket bolts are installed and tightened
C remove three flange mount bolts (2) and recheck
C alignment. If alignment is not within 1/16 inch,
C repeat operations (17) through (23). If alignment
C is still out of limits, advise MCIEE of final
C misalignment figures.

C (28) After alignment is within limits, all clamp nuts
C and mounting bracket bolts torqued, install bolts
C (2) at three bolt flange at fuel filter and tighten.

(29) Fit and secure tubes (9) and (8), positioning bracket under bolt heads at H.P. pump inlet.

Engines with S.B.73-4404, reconnect tube (9) support clip to electrical harness support bracket.

(30) CAUTION: FOR FUEL PUMPS FEATURING LUCAS MODIFICATION CP.4771, CP.4779 OR CP.5230 VISUALLY INSPECT THE SPILL VALVE INLET BORE TO CONFIRM INCORPORATION OF THE DAMPING ORIFICE BOBBIN. FOR FUEL PUMPS FEATURING CP.4779 OR CP.5230 IDENTIFICATION OF THE STRAINER (INTERNAL TO THE BOBBIN) IS SUFFICIENT TO CONFIRM INCORPORATION OF THE BOBBIN
Refer to Fig.403 (Sheet 2) fit tube (7).

(31) Fit tube (6), position bracket on connector at spill valve then secure tubes (7) and (6). Fit and secure tube (6) support clip.

(32) Fit and secure tube (5).

(33) Refer to fig.403 (Sheet 1), connect and tighten (Ref. 70-51-00) connector (4) and wirelock.

R (34) On engines without S.B.73-8105. Fit and libricate a new
R seal ring. Fit and secure tube (3). Torque tighten connector securing nuts and bolts to between 80 and 100 lbf.in. (9.05 to 11.30 Nm.).

(35) On engines with S.B.73-8105. Refer to Fig.403 (sheet 5) fit fuel tube and heat shield (8).

R (a) Fit and lubricate a new seal (9).

(b) Fit nuts and bolts (6,7) at flanged connection and at Low Pressure Fuel Pump connection, torque tighten 80 to 100 lbf.in.

(c) Fit plate (3) to bracket support secure with nuts and bolts (1,2).

(d) Wire lock insulation blankets (10,11) to bracket support.

(e) Prepare surface of heat shield (8) and nut cover (5) to T.S.D.594 O.P.707.

(f) Position nut cover (5) and bond to heat shield using SILCOSET 152 T.S.D.594 O.P.707.

R (g) Put the safety retaining pin (4) through the holes
R in the spigots which protrude through the holes in
R the nut cover assembly (5). Fasten the pin.

(h) Apply a bead of bonding agent and bond safety pin to cover.

(36) Refer to fig.403 (Sheet 1), connect and secure electrical connector (2).

(37) On engines incorporating S.B.73-2232, connect and tighten (Ref. 70-51-00) connector (1) and wirelock.

(38) Refer to fig.403 (Sheet 4), connect and secure tube support clips to bracket at connector (12).

(39) On engines incorporating S.B.72-2564 refer to fig.401, position support bracket (3) then fit and secure bolts and washers (2). Fit and secure bolts, spring washers and spreader washers (1).

(40) Reactivate systems deactivated in operations A. (2) through (4).

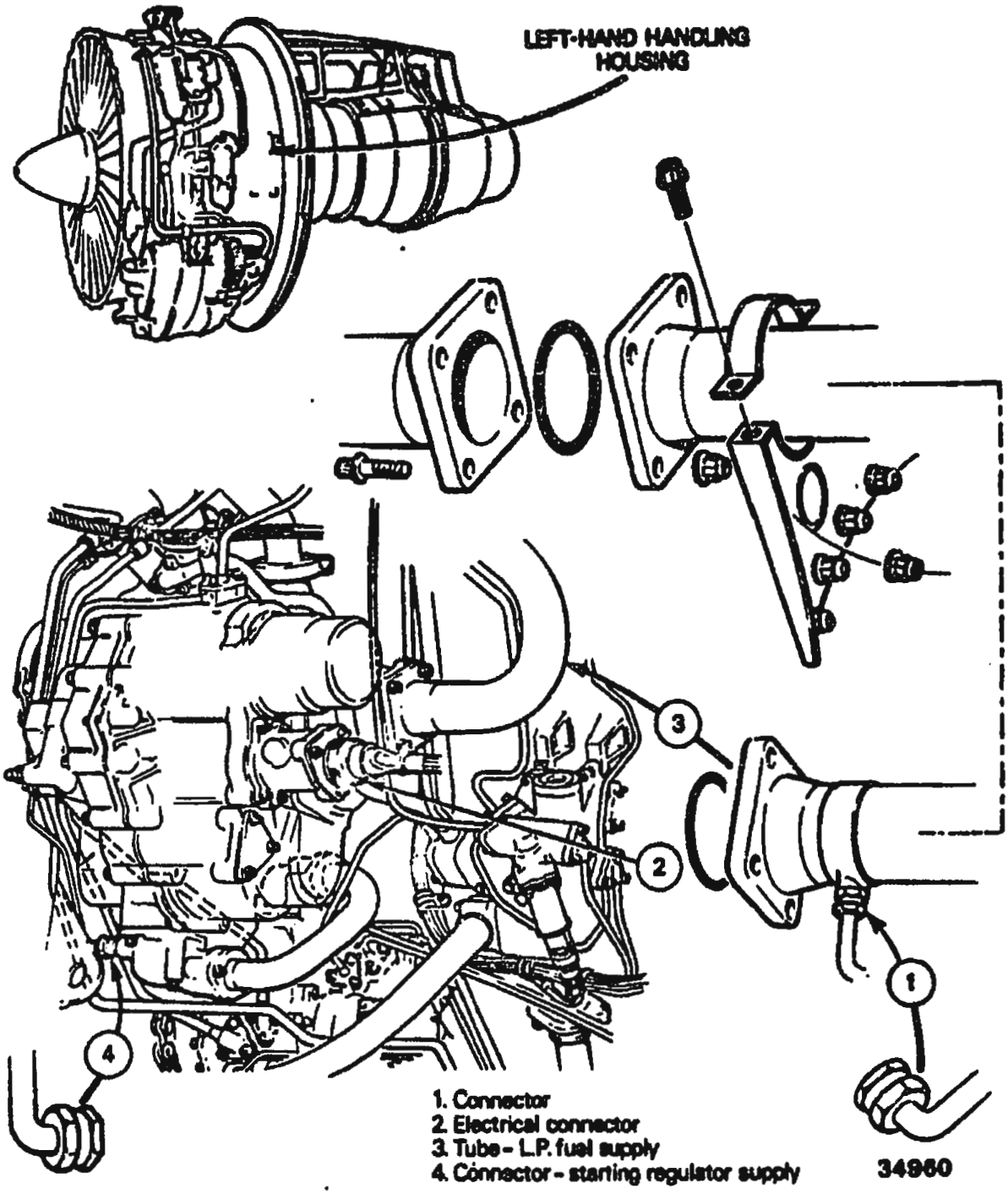
(41) Prime L.P. fuel system (Ref. 73-00-00, Servicing) and check for leaks (Ref. 73-00-00, Adjustment/Test).

(42) Perform Functional Test of Variable Restrictor and Actuator as detailed in 73-11-01, Adjustment/Test.

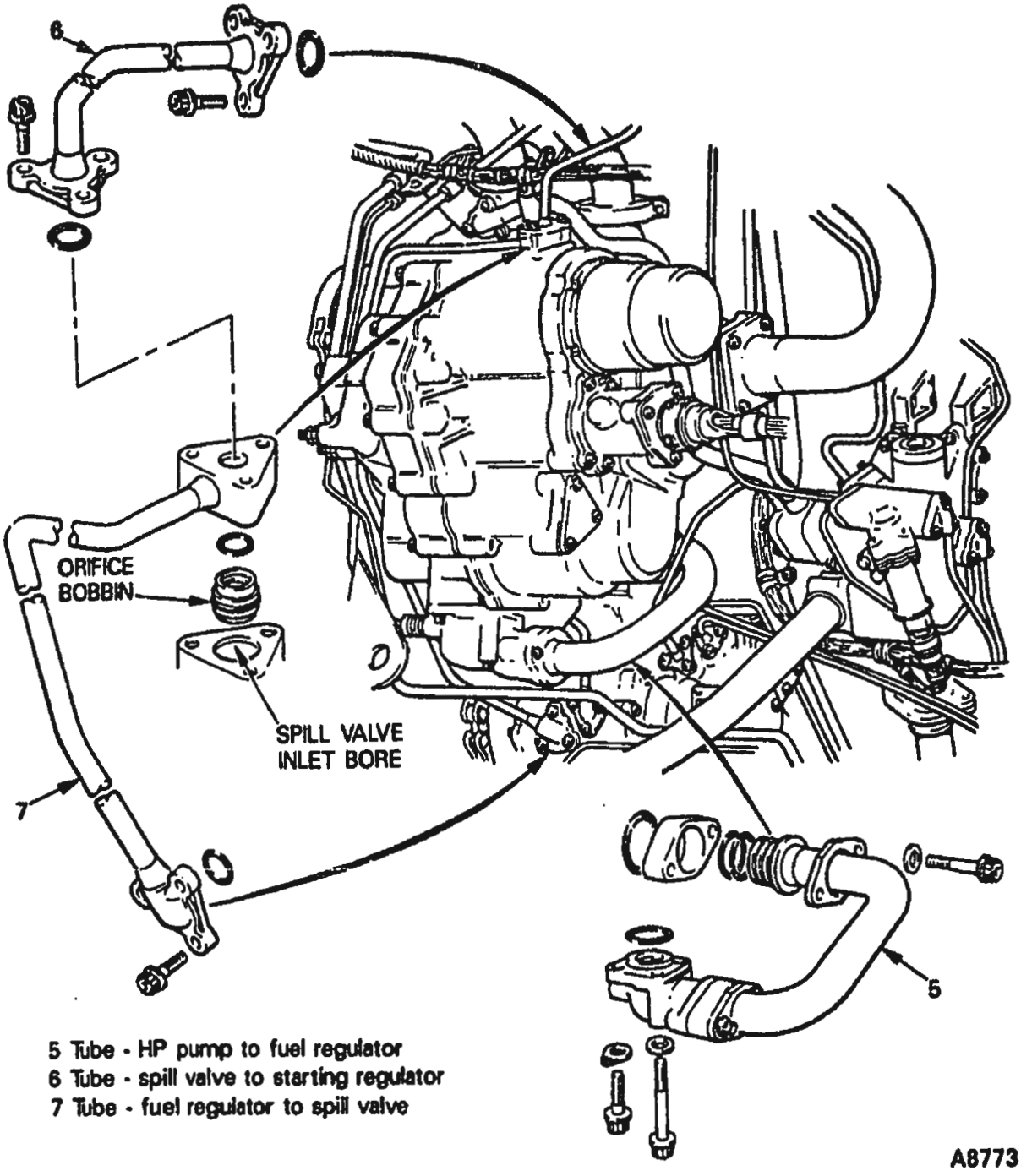
C NOTE: 1. Test No.8 - Speed and Temperature Control Amplifier Redatum and Override Test (Ref. 71-00-00, Adjustment/Test) may be used as an alternative.

C 2. Test No.18 Fuel Control Amplifier Function
C Test (Ref. 71-00-00, Adjustment/Test) may be
C used when suitable test sets are not available
C and high power running is prohibited.

(43) Close left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL for engine No.2 (Ref. 71-12-01).



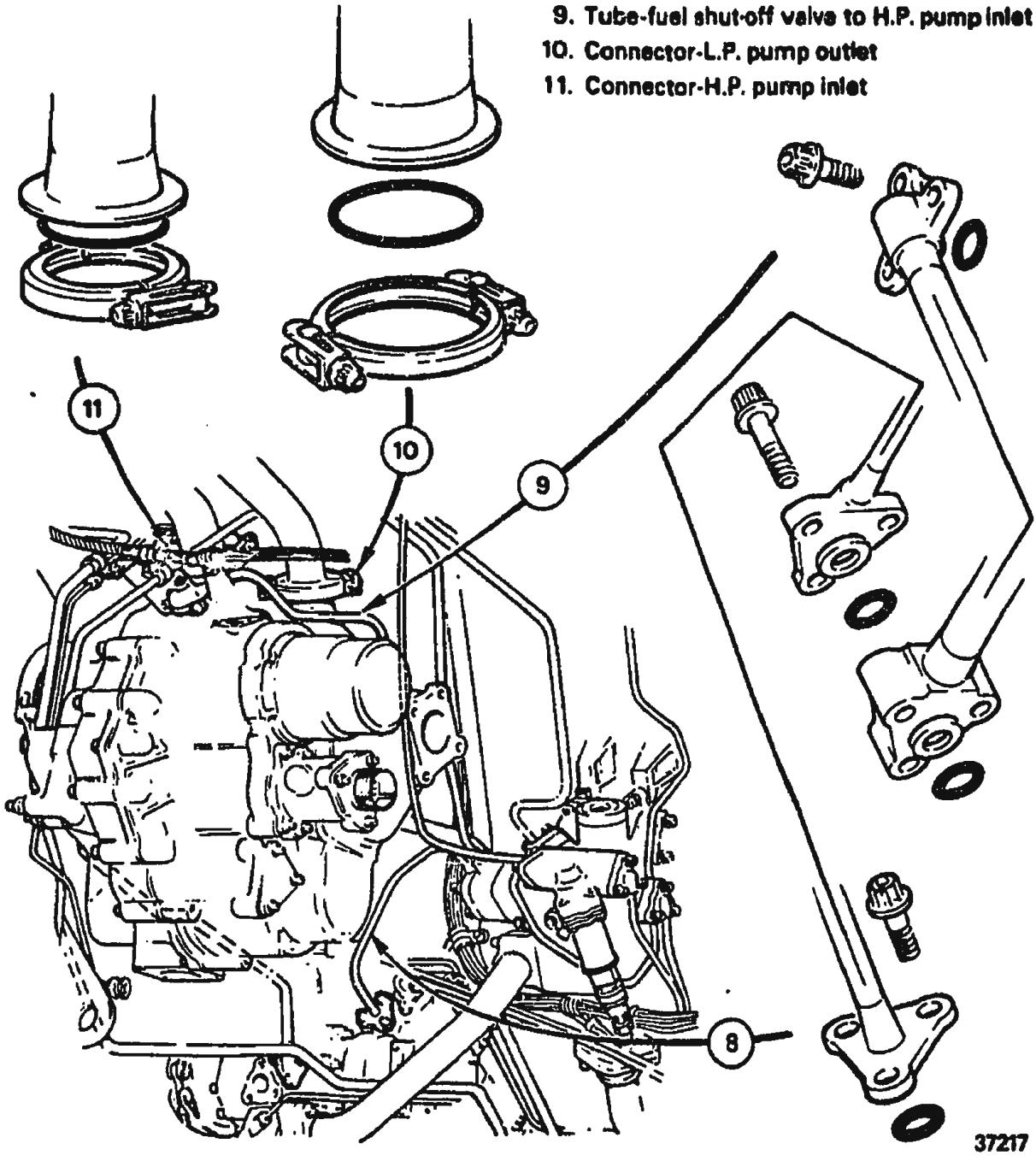
Combined fuel pump assembly disconnect points
Fig.403 (Sheet 1)



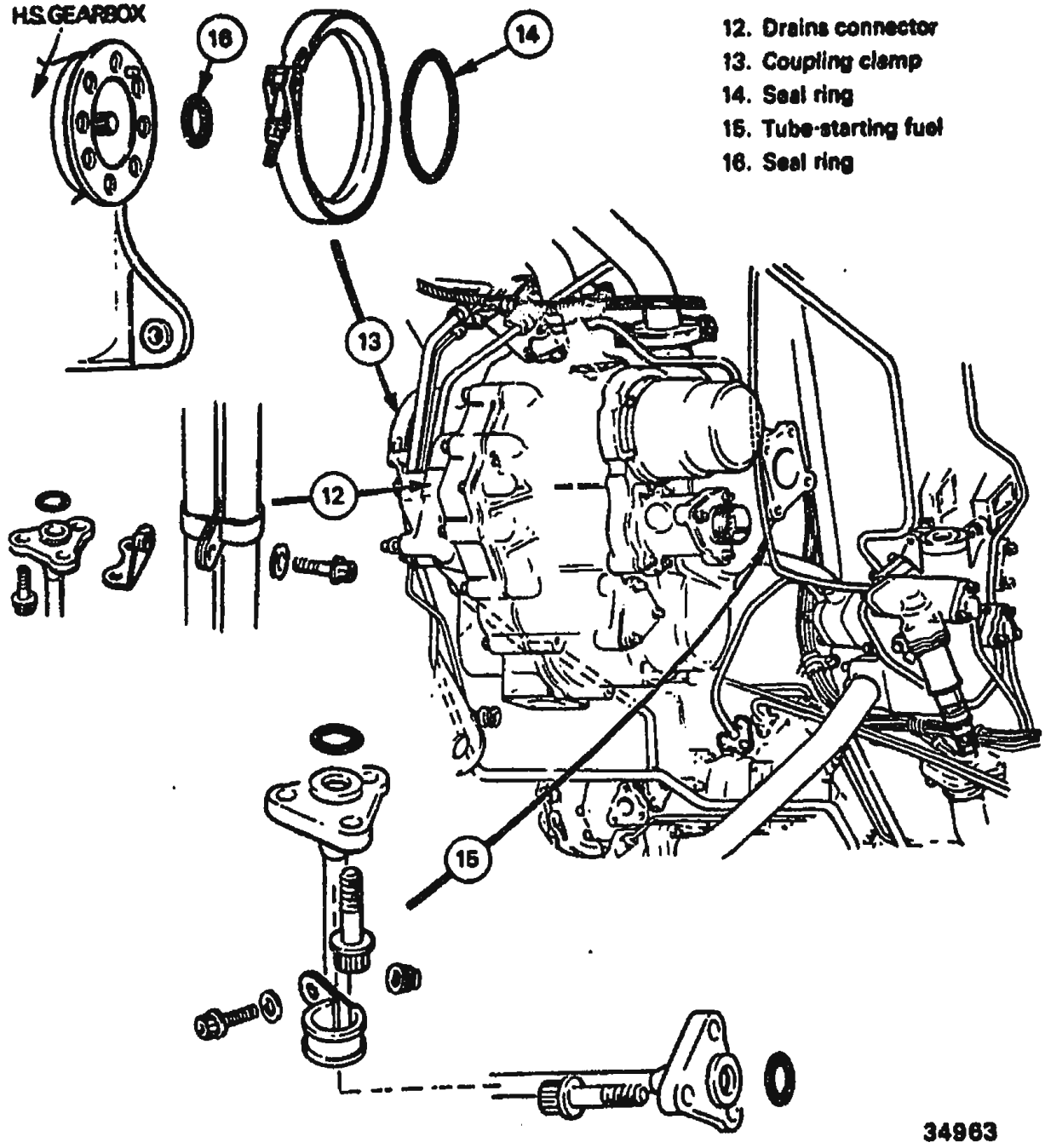
R Combined fuel pump assembly disconnect points
R Fig.403 (Sheet 2)

EFFECTIVITY: ALL

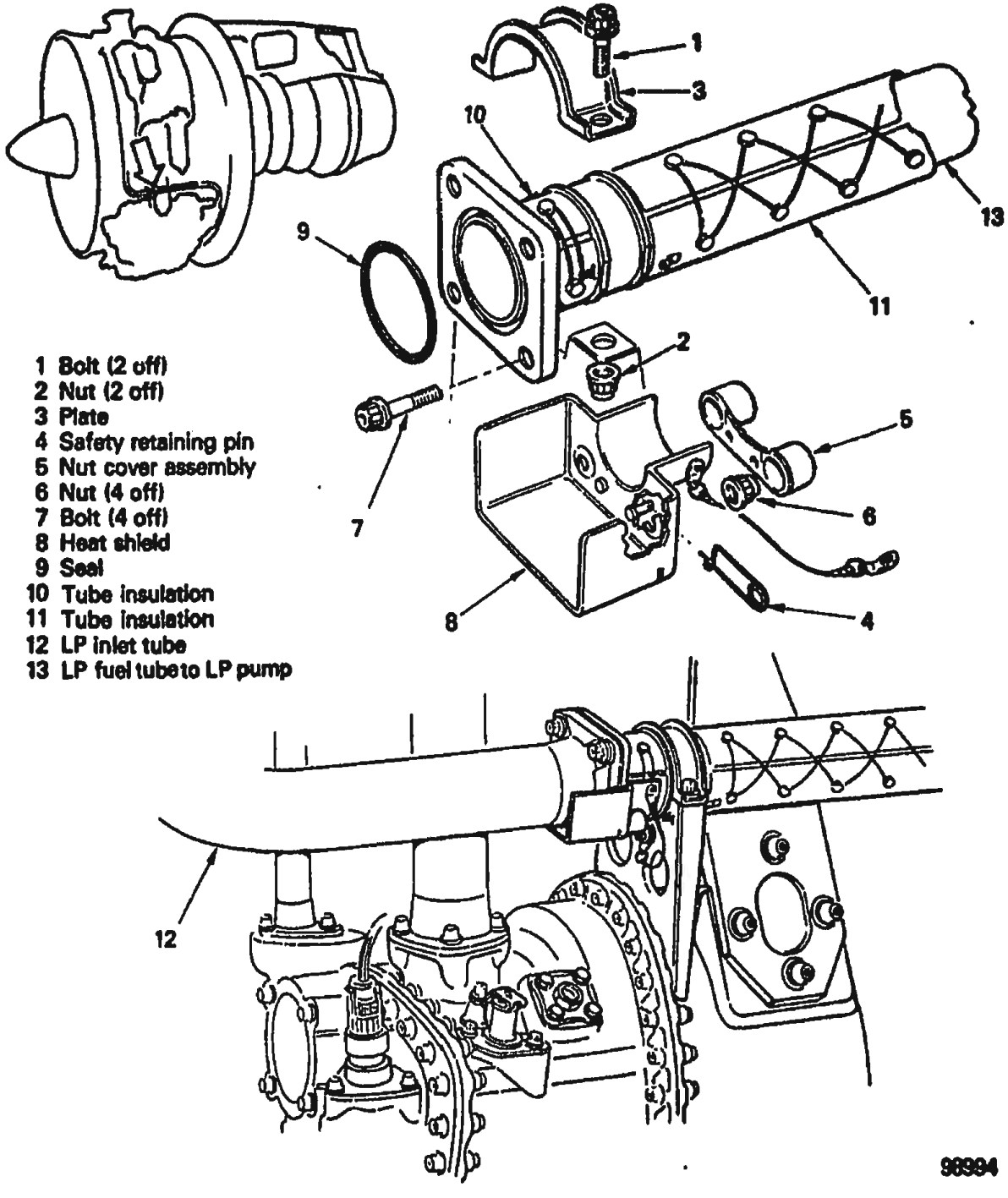
8. Tube-fuel regulator to fuel shut-off valve
9. Tube-fuel shut-off valve to H.P. pump inlet
10. Connector-L.P. pump outlet
11. Connector-H.P. pump inlet



Combined fuel pump assembly disconnect points
Fig.403 (Sheet 3)



Combined fuel pump assembly disconnect points
Fig.403 (Sheet 4)



Combined fuel pump assembly disconnect points
Engines with S.B.73-8105
Fig.403 (sheet 5)

LOW PRESSURE FUEL PUMP - ADJUSTMENT/TEST

1. Test Variable Restrictor and Actuator

CAUTION: ENSURE ELECTRICAL CONNECTORS ARE FREE FROM SOLID AND/OR LIQUID CONTAMINATION BEFORE CONNECTING AND DISCONNECTING. FAILURE TO DO SO CAN RESULT IN A FIRE.

Referenced Procedures:

24-41-00	External Power/Ground Service System
70-50-02	Connection of Electrical Plugs
71-11-00	Cowlings, Engine No.1 and No.3 - Servicing
71-12-01	L.H. and R.H. Lower Hinged Cowl - Servicing
71-12-05	L.H. and R.H. Upper Hinged Cowl - Servicing
73-00-00	Fuel System - Fault Isolation
73-21-00	Fuel Control System - Adjustment/Test

A. Functionally Test Variable Restrictor and Actuator Using Test Sets UT.1000 or UT.1000/1 or UT.1000/2.

(1) Equipment required:

UT.1000/1	Test set
UT.937/1	Lead
UT.997	Lead
UT.998	Lead
UT.1144	Lead (Used in conjunction with lead UT.998)
U.999127	Carrying case

(2) Open L.H. hinged cowl 413A or 423A for engines No.1 and 3 (Ref.71-11-00) or 433DL for engine No.2 (Ref. 71-12-05).

(3) Ensure amplifier test switch (zone 210) and amplifier override switch (zone 215) are set to normal (light out).

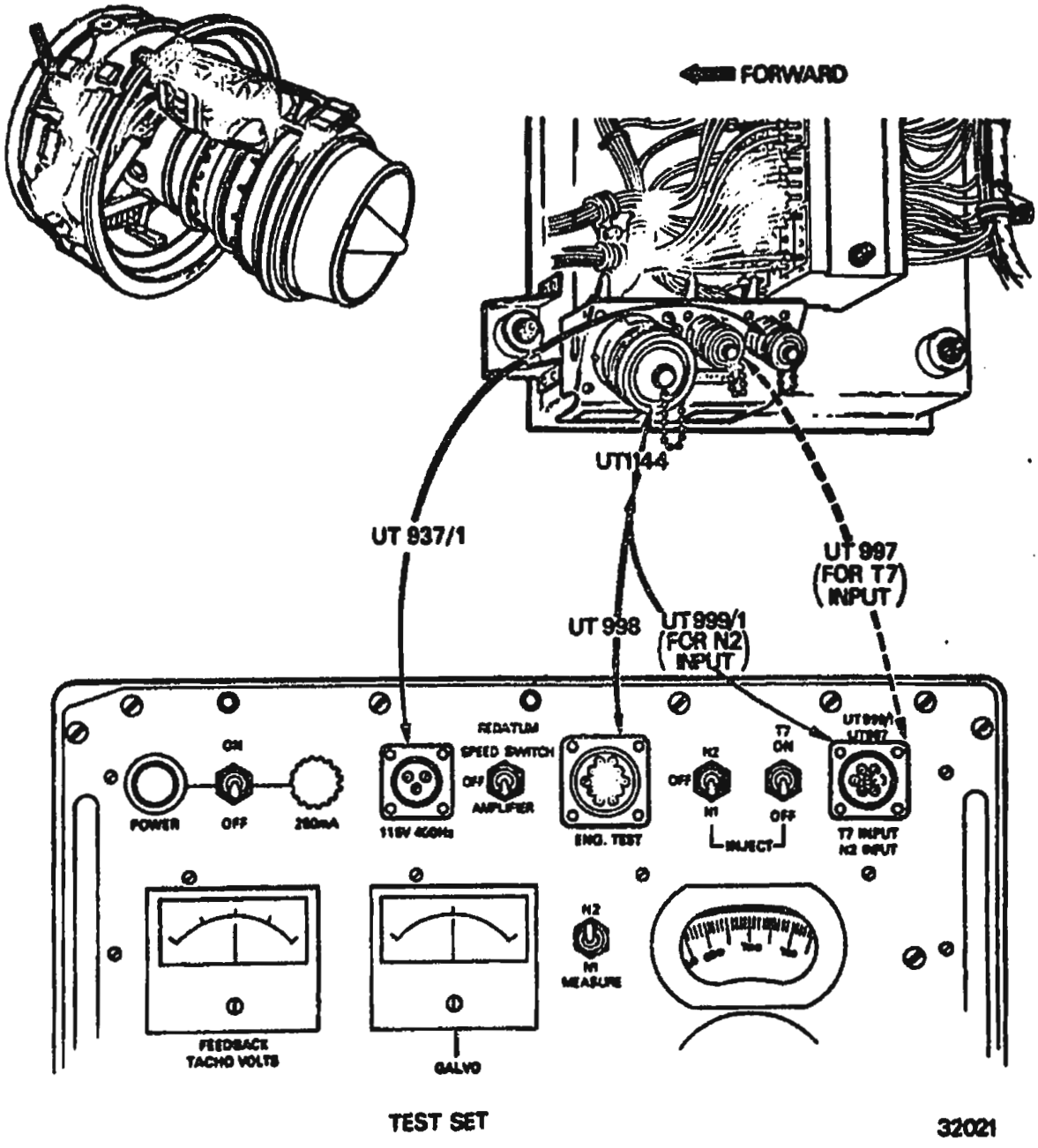
(4) Prepare for testing.

(a) Remove test set cover.

. C

FIGURE DELETED

Test set UT.1000 to engine, test lead connections
Fig.501

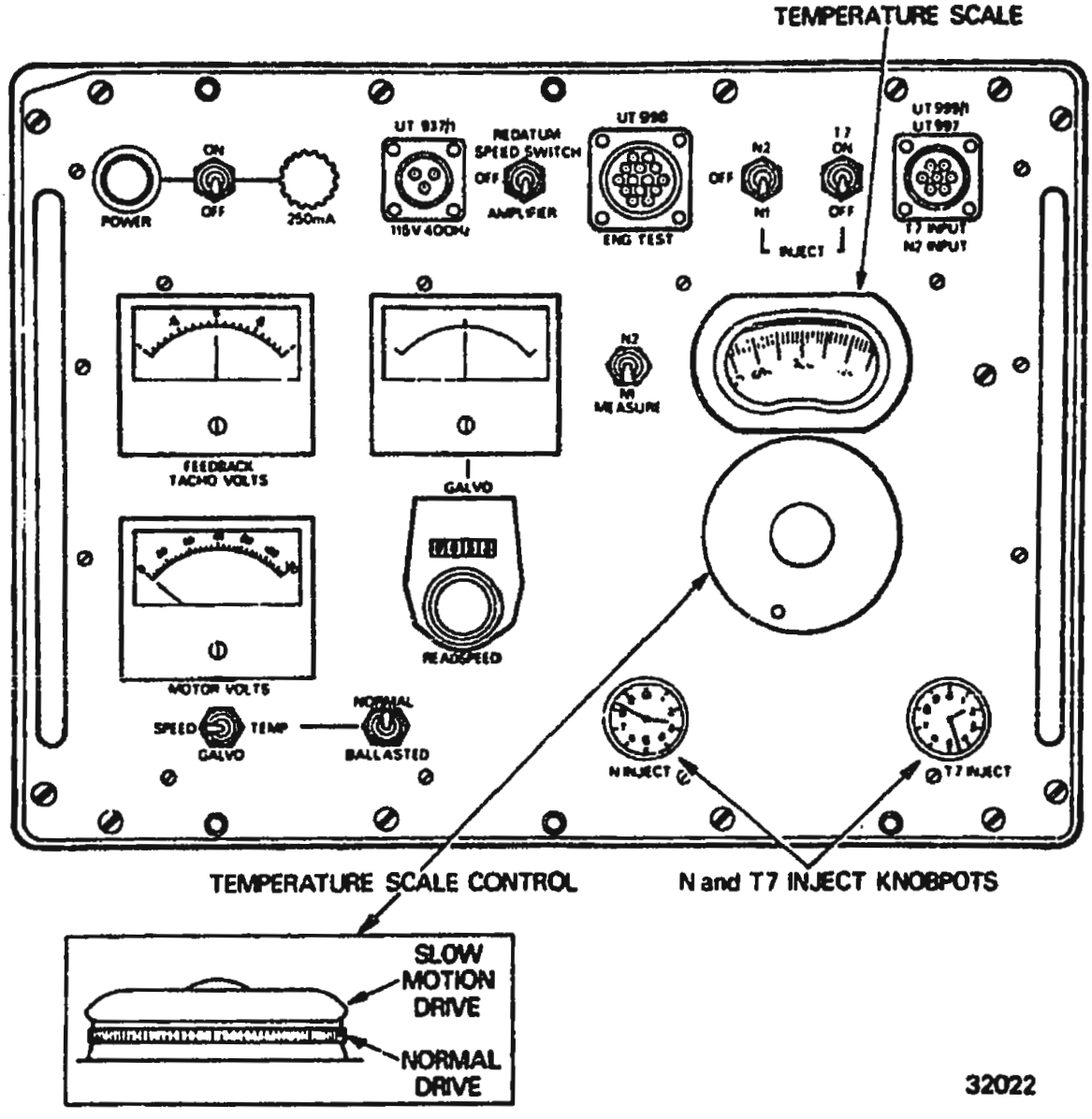


Test set UT.1000/1 to engine, test lead connections
Fig.502

C

FIGURE DELETED

Test set UT.1000 front panel
Fig.503



Test set UT.1000/1 or UT.1000/2 front panel
Fig.504

C (b) Refer to fig.502 for test set UT.1000/1 connect test set to engine test connectors as shown.

C C NOTE: When using test set UT.1000/1 (Ref. fig.502), use N2 input lead UT.997.

(c) Energize ground services system (Ref. 24-41-00).

C (d) Refer to fig.504 for test set UT.1000/1, select test set power supply switch ON and check POWER indicator light comes on. Allow 2 minutes for test set to stabilize.

C (5) Test speed datum setting as detailed in 73-21-00, Adjustment/Test.

(6) Effect the following sequence of operations (a) through (f):

C (a) Reduce Readspeed setting by 0.1% from datum setting obtained at 1.A. (5) using N1 or N inject knobpot.

(b) Select fuel control amplifier OVRD switch (zone 215) to override position and check light comes on.

C (c) Select DATUM select switch to AMPLIFIER on test set UT.1000/1 and wait for approximately 45 secs.

(d) Select OVRD switch to normal (light out). At this stage an error signal of 15% N1 or 10% N2 is transmitted to the amplifier, and the variable orifice will move rapidly to full trim position.

(e) Check voltage registered on FEEDBACK TACHO VOLTS gauge is not less than 0.3V at the highest point and the duration of the registered voltage does not exceed 10 seconds.

(f) If the registered voltage is less than 0.3V or the duration exceeds 10 seconds, refer to 73-00-00, Fault Isolation (Redatum System/Variable Restrictor Inoperative).

(7) Select test set power supply switch OFF.

(8) De-energize ground services system (Ref. 24-41-00).

(9) Disconnect test leads from engine and test set. Fit dust covers to all connectors.

(10) Fit test set cover.

(11) Close L.H. hinged cowl 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433DL for engine No.2 (Ref. 71-12-05).

B. Trim Actuator Motor and Insulation Resistance Check

(1) Equipment required:

Wheatstone Bridge or similar test equipment
Insulation tester, 50 megohms at 500 V d.c.

(2) On Flight Engineers/Second Officers aft circuit breaker panel CB3, zone 215, open and tag appropriate FUEL CONT AMP circuit breaker.

(3) On pilots centre console, zone 210, ensure appropriate Fuel Control Amplifier Test Switch in OFF position.

(4) Open L.H. hinged cowl; 413A or 423A for engines No.1 and 3 (Ref.71-11-00) or 433AL for engine No.2 (Ref.71-12-01).

(5) CAUTION: ENSURE ELECTRICAL CONNECTOR IS FREE FROM SOLID AND/OR LIQUID CONTAMINATION BEFORE DISCONNECTING.

Disconnect Fuel Pump Variable Restrictor Actuator electrical connector 7321-P702.

(6) Check insulation resistance

(a) Using a 500 V d.c. insulation resistance tester check the insulation resistance between the actuator windings, and between the actuator windings and the case are within the following limits:

Receptacle 7321-J702 pin number From	To	Insulation resistance (Megohms)
12	8	In each instance the indicated resistance must be greater than 20 Megohms
12	6	
12	Unit case	
8	11	
8	6	
8	Unit case	
11	6	
6	Unit case	

(7) Check actuator winding resistance

R (a) Using a Wheatstone Bridge at receptacle 7321-J702, check the resistance of the motor and
R tacho-generator windings are within the limitations
R as detailed in Fig.505.

(8) If any of the resistance values are outside the limits stated in operations (6) and (7) the fuel pump must be replaced.

(9) CAUTION: ENSURE ELECTRICAL CONNECTOR IS FREE FROM SOLID AND/OR LIQUID CONTAMINATION BEFORE CONNECTING.

Connect (Ref.70-50-02) Fuel Pump Variable Restrictor Actuator electrical connector 7321-P702.

(10) Close L.H. hinged cowl; 413A or 423A for engines No.1 and 3 (Ref.71-11-00) or 433AL for engine No.2 (Ref.71-12-01).

(11) Close FUEL CONT AMP circuit breaker and remove tag.

AMBIENT TEMPERATURE DEG.C.	WINDING RESISTANCE LIMITS (OHMS) Between Pyle Receptacle Pin Numbers			
	12 and 3	8 and 9	11 and 3	6 and 5
10	51.5 to 63.5	51.5 to 63.5	533 to 652	845 to 1029
12	52.0 to 64.0	52.0 to 64.0	538 to 658	852 to 1038
14	52.5 to 64.5	52.5 to 64.5	543 to 664	859 to 1047
16	53.0 to 65.0	53.0 to 65.0	548 to 670	866 to 1056
18	53.5 to 65.5	53.5 to 65.5	553 to 676	873 to 1065
20	54.0 to 66.0	54.0 to 66.0	558 to 682	880 to 1074
22	54.5 to 66.5	54.5 to 66.5	563 to 688	887 to 1083
24	55.0 to 67.0	55.0 to 67.0	568 to 694	894 to 1092
26	55.5 to 67.5	55.5 to 67.5	573 to 700	901 to 1101
28	56.0 to 68.0	56.0 to 68.0	578 to 706	908 to 1110
30	56.5 to 68.5	56.5 to 68.5	583 to 712	915 to 1119
32	57.0 to 69.0	57.0 to 69.0	588 to 718	922 to 1128
34	57.5 to 69.5	57.5 to 69.5	593 to 724	929 to 1137
36	58.0 to 70.0	58.0 to 70.0	598 to 730	936 to 1146
38	58.5 to 70.5	58.5 to 70.5	603 to 736	943 to 1155
40	59.0 to 71.0	59.0 to 71.0	608 to 742	950 to 1164
42	59.5 to 71.5	59.5 to 71.5	613 to 748	957 to 1173
44	60.0 to 72.0	60.0 to 72.0	618 to 754	964 to 1182
46	60.5 to 72.5	60.5 to 72.5	623 to 760	971 to 1191
48	61.0 to 73.0	61.0 to 73.0	628 to 766	978 to 1200
50	61.5 to 73.5	61.5 to 73.5	633 to 772	985 to 1209

A2015

R Fuel Trim Actuator - Actuator Winding Resistance Limits
R Fig.505

R EFFECTIVITY: ALL
R
050B 2G

R LOW PRESSURE (L.P.) FUEL PUMP - INSPECTION/CHECK

R 1. General

R A. The L.P. fuel pump with the H.P. fuel pump form the combined
R fuel pump assembly. The following instructions apply to the
R combined pump assemblies identified by CP.4771, CP.4779 or
R CP.5230.

R B. Service Bulletins referred to:

R	SB 73-3356	FUEL AND CONTROL - H.P. and L.P. fuel pumps - Introduction of a spill valve damping orifice into H.P. fuel pump servo connection LUCAS SB PAC.101-73-24, Mod.CP.4771
R	SB 73-3402	FUEL AND CONTROL - Pump and control - Introduction of re-designed trim valve and new spill valve orifice bobbin LUCAS SB PAC.101-73-33, Mod.CP.4779
R	SB 73-4776	FUEL AND CONTROL - H.P. and L.P. fuel pumps - Revised actuator valve sleeve/metering slots and spill valve damping orifice LUCAS SB PAC 101-73-58, Mod.CP.5230

R C. Referenced Procedures

R	71-00-00	Power Plant - Adjustment/Test
R	73-00-00	Engine Fuel and Control - Servicing
R	73-11-00	Low Pressure Fuel Pump - Removal/Installation

R D. Illustrated Parts Catalogue References:

R The I.P.C. sections where parts disturbed during the following
R operations can be located are as follows:

R	73-11-01	L.P. and H.P. Fuel Pump Installation
R	73-11-09	Fuel System, H.P. Fuel Tubes
R	73-11-07	Fuel System, L.P. Fuel Tubes

R 2. Inspect the Combined Fuel Pump Assembly

R A. Inspect the combined fuel pump assembly to confirm presence
R of spill valve damping orifice bobbin.

R (1) Drain L.P. fuel system
R (Ref.73-00-00, 301 Engine Fuel and Control, Servicing).

R (2) Remove fuel tubes
R (Ref.73-11-01, 401 Combined Fuel Pump Assembly -
R Removal/Installation).

R (a) Remove tube - spill valve to starting regulator.

R (b) Remove tube - fuel regulator to spill valve.

R (3) Visually inspect (Ref.Fig.601) spill valve inlet bore
R to confirm incorporation of spill valve damping orifice
R bobbin.

R NOTE: For fuel pumps featuring CP.4779 or CP.5230
R identification of the strainer (internal to the
R bobbin) is sufficient to confirm incorporation
R of the bobbin.

R (4) If the spill valve damping orifice bobbin is not
R incorporated - REJECT ENGINE and contact R-R plc.

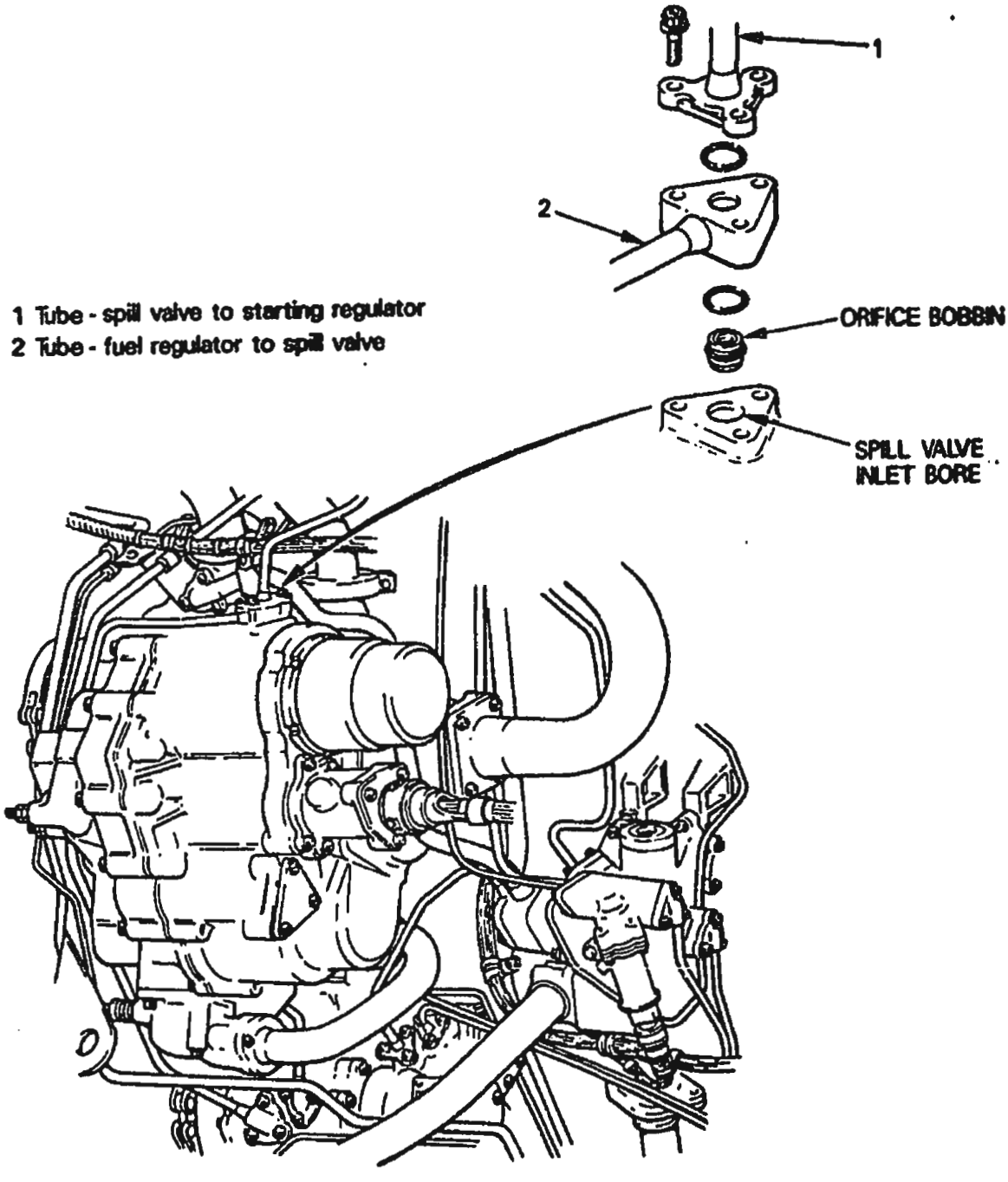
R (5) Install fuel tubes
R (Ref.73-11-01, 401 Combined Fuel Pump Assembly -
R Removal/Installation).

R (a) Fit tube - fuel regulator to spill valve.

R (b) Fit tube - spill valve to starting regulator.

R (6) Prime L.P. fuel system
R (Ref.73-00-00, 301 Engine Fuel and Control - Servicing).

R (7) Do Test No.2 - Fuel and Oil Leak Test at connections
R disturbed during the previous operations
R (Ref.71-00-00, 501 Power Plant - Adjustment/Test).



R Combined Fuel Pump Assembly - Inspection/Check
R Fig.601

R EFFECTIVITY: ALL
R
050B 1

LOW PRESSURE FUEL FILTER - MAINTENANCE PRACTICES

Service Bulletins referred to:

S.B.73-4473 - Filter drain valve replaced by drain plug.

1. Removal/Installation Fuel Filter Element

A. Remove Fuel Filter Element

(1) Equipment required:

Clean receptacle - minimum capacity:

5 U.S. gallons
4 Imperial gallons
18 Litres

(2) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag appropriate FUEL LOW PRESS and FUEL temp circuit breakers.

(3) On pilots overhead control panel, zone 210, pull appropriate Fire Emergency Shutoff Control.

(4) Open left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00, Servicing) or 433AL for engine No.2 (Ref. 71-12-01, Servicing).

(5) Engines with S.B.73-4473:

(a) Refer to fig.201, position receptacle under drain plug (1), then remove drain plug.

(b) When fuel flow ceases, fit and lubricate (Ref. 70-20-01) a new seal ring to drain plug.

(c) Fit and secure drain plug and wirelock.

R (6) Release bolts (2) and remove cover (3).

R (7) Withdraw element (4) from cover.

B. Install Fuel Filter Element

(1) Material required:

Clean engine fuel (Ref. 12-11-00)

(2) Ensure appropriate systems are deactivated as detailed in operations A.(2) and (3).

(3) Refer to fig.201 and, using clean engine fuel, clean inside of cover (3).

(4) Depress and release element retainer (6) and ensure retainer abuts underside of bolt head (7).

(5) Fit and lubricate (Ref. 70-02-01) a new seal ring (5) to cover (3).

(6) Fit new element (4) to cover (3).

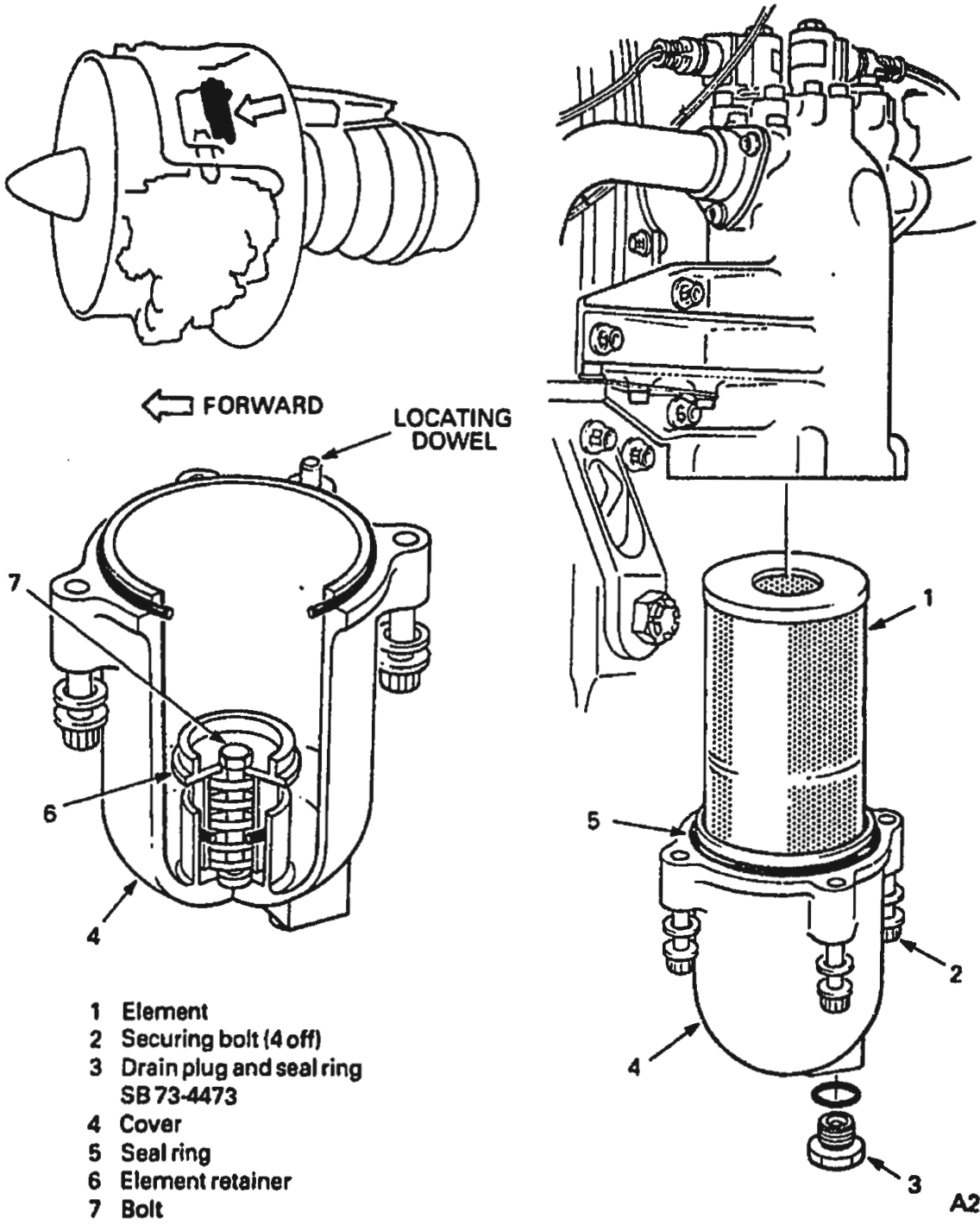
(7) CAUTION: ENSURE ELEMENT (4) IS CORRECTLY LOCATED ON THE SPIGGOTS ON THE ELEMENT RETAINER AND THE FILTER HOUSING BEFORE TIGHTENING BOLTS (2).

Position cover (3) on filter housing ensuring positive location of dowel, and secure bolts (2).

(8) Reactivate systems deactivated in operations A.(2) and (3).

(9) Prime L.P. fuel system (Ref. 73-00-00, Servicing) and test for leaks at points disturbed (Ref. 73-00-00, Adjustment/Test).

(10) Close left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00, Servicing) or 433AL for engine No.2 (Ref. 71-12-01, Servicing).



1 Element
2 Securing bolt (4 off)
3 Drain plug and seal ring SB 73-4473
4 Cover
5 Seal ring
6 Element retainer
7 Bolt

R Fuel filter element removal/installation
R Fig.201

R EFFECTIVITY: ALL
R

HIGH PRESSURE FUEL PUMP - MAINTENANCE PRACTICES

1. Removal/Installation H.P. Fuel Pump

The H.P. fuel pump with the L.P. fuel pump form the combined fuel pump assembly. The removal/installation of this assembly is given in 73-11-01.

HIGH PRESSURE FUEL SHUT-OFF VALVE - REMOVAL/INSTALLATION

The Removal/Installation procedures described in this section are as follows:

Paragraph	Procedure
1.	Remove H.P. Fuel Shut-off Valve
2.	Inhibit H.P. Fuel Shut-off Valve
3.	Install H.P. Fuel Shut-off Valve

Service Bulletins referred to:

S.B.71-2577	Engine Light Duty Electrical Harness - Addition clipping to avoid frettage
S.B.73-3985	Introduction of Fuel Restrictor Bobbin in Cold Day Enrichment Solenoid Inlet
S.B.71-4581	Additional Clipping Position on Shut-Off Valve.

Referenced Procedures

	70-02-01	Identification, Lubrication and Fitting of Rubber Sealing Rings
R	71-00-00	Power Plant - Adjustment/Test
	71-11-00	Cowling, Engines No.1 and No.3 - Servicing
	71-12-01	L.H. and R.H. Lower Hinged Cowls - Servicing
	73-11-02	Low Pressure Fuel Filter - Maintenance Practices
	73-11-09	Fuel Tubes - Maintenance Practices
	73-21-07	Cold Day Enrichment Solenoid - Maintenance Practices

Illustrated Parts Catalogue References

The I.P.C. sections where parts disturbed during the following operations can be located are as follows:

71-70-02	Engine Drain Tubes
73-11-04	H.P. Fuel Shut-off Valve
73-11-09	Fuel System Tubes

1. Remove H.P. Fuel Shut-off Valve

A. Equipment required:

Clean receptacle - minimum capacity
5 U.S. gallons
4 Imperial gallons
18 Litres
Flexible hose - approximate length 72in. (1800 mm.)
internal diameter 0.5in. (12 mm.)

B. On pilots overhead circuit breaker panel CB3, zone 210, open and tag appropriate FUEL SHUT-OFF VALVE circuit breaker.

C. On pilots centre console zone 210, place appropriate Fuel and Ignition Switch in OFF position.

D. On pilots overhead control panel, zone 210, pull appropriate Fire Emergency Shut-off Control.

E. Open L.H. hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or remove lower L.H. hinged cowl panel 433AL and L.H. mid fixed cowl 433CL (Ref. 71-12-03).

F. Drain L.P. fuel filter (Ref. 73-11-02).

G. Refer to fig.401, disconnect fuel enrichment solenoid electrical connector (2).

H. Release harness support clip from bracket at connector (8).

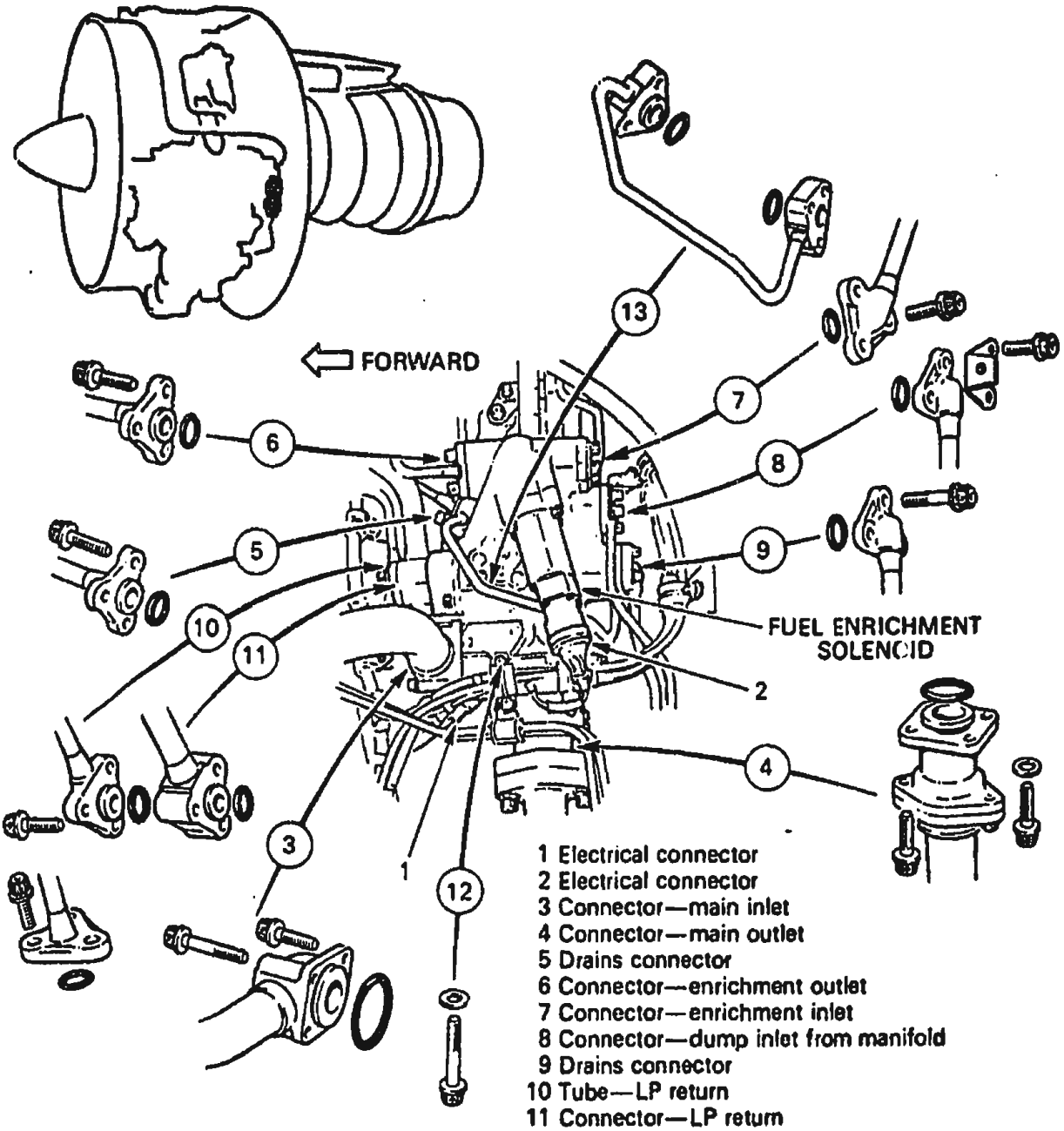
J. Disconnect connectors (3) through (9), leave brackets at connectors (4) and (7) connected to harness and tube support clips.

On engines incorporating S.B.71-2577 leave bracket at connector (3) attached to harness.

On engines incorporating S.B.4581 leave bracket at connector (6) attached to harness.

K. Remove tube (10), and disconnect connector (11) sandwiched between tube (10) and shut-off valve.

L. Remove bolts and washers (12) and partially withdraw unit from support bracket.



1 Electrical connector
2 Electrical connector
3 Connector—main inlet
4 Connector—main outlet
5 Drains connector
6 Connector—enrichment outlet
7 Connector—enrichment inlet
8 Connector—dump inlet from manifold
9 Drains connector
10 Tube—LP return
11 Connector—LP return
12 Securing bolt and washer (3 off)
13 Drain tube

26097C

R H.P. fuel shut-off valve - removal/installation
R Fig.401

M. Support unit in a suitable position and disconnect shut-off valve electrical connector (1).

N. Place unit on work surface and remove tube (13); retain tube for fitment to new unit.

R P. Remove restrictor from the fuel enrichment valve inlet and
R retain restrictor for fitment to new unit. Remove and discard
R seal.

R Q. Fit blanks to all exposed apertures and connectors.

R R. Inhibit unit as described in para.2.

2. Inhibit H.P. Fuel Shut-Off Valve

Inhibiting can be delayed for up to 48 hours provided all connectors and apertures are suitably blanked.

A. Equipment required:

Fluid container, fitted with fine mesh filter

B. Material required:

Inhibiting fluid	British spec. D.T.D.5578 or D.Eng.R.D.2490	American spec. MIL-L-7870A MIL-L-6081C ASG (grade 1010)
White spirit or Stoddard solvent	B.S.245	ASTM D.484-52

C. Drain all fuel from unit.

D. Fit transportation covers and gaskets to all apertures and blanking caps to electrical connector.

E. Thoroughly clean unit exterior with white spirit or Stoddard solvent, then dry unit.

F. Remove covers from fuel apertures on unit.

G. Using fluid container pour inhibiting fluid into main inlet, drain inlet, enrichment outlet and L.P. outlet apertures until full, then refit covers to these apertures.

H. Pour inhibiting fluid into main outlet, drain outlet, dump inlet and enrichment inlet apertures until full, then refit covers to these apertures.

J. Turn unit over several times to distribute inhibiting fluid, then top up fluid level by removing and refitting each cover in turn.

K. Clean and dry unit exterior.

L. Leave unit for 30 minutes then examine each cover for signs of leakage. Renew any defective gaskets, topping up fluid level as required. Repeat this operation until no leakage is apparent.

M. Attach label to unit recording date and details of inhibiting.

3. Install H.P. Fuel Shut-off Valve

Refer to 73-11-09 for correct procedure for fitting fuel tubes

A. Equipment required:

Clean receptacle - minimum capacity

1 U.S. gallon
1 Imperial gallon
4 Litres

B. Ensure appropriate systems are deactivated as detailed in operations 1.B. through D.

R C. Remove blanks and gaskets, if fitted, from all apertures and drain off inhibiting fluid.

R D. Remove blanks and gaskets from electrical connectors.

E. Ensure all mating apertures and connector faces are clean and free from damage.

F. Refer to fig.401, fit and lubricate (Ref. 70-02-01) new seal rings to all tube end connectors.

G. Fit tube (13) to unit.

R H. Fit new seal ring to restrictor (Ref. 70-02-01, Maintenance
R Practices).

R J. Fit restrictor to the fuel enrichment valve inlet.

CR K. Raise unit to a position where wire harnesses will
C reach and connect and secure electrical connector (1).

CR L. Fit unit to support bracket and loosely install one or two securing bolts and washers.

C NOTE: Leave bolts loose so that unit can readily be
C moved about to facilitate installation of
C tubing connectors.

CR M. Connect and secure connectors (8) then (9) then (7) positioning brackets under bolts at connectors (8) and (7).

CR N. Connect and secure connector (5), then position
C connector (11) on shut-off valve, fit and secure
C tube (10).

CR P. Connect and secure connectors (3), then (4), then (6), positioning brackets under bolts at connector (4).

On engines incorporating S.B.71-2577, also position bracket under bolts at connector (3).

On engines incorporating S.B.71-4581, position bracket under bolts at connector (6).

CR Q. Connect and secure electrical connector (2).

CR R. Install remaining valve mounting bolt(s) and washer(s)
C and secure the three mounting bolts.

CR S. Secure harness clip to bracket at connector (8).

CR T. Activate systems deactivated in operations A.(2). through (4).

R U. Before next flight, perform Test No.2 (Ref. 71-00-00).

C V. Before next flight operationally test H.P. shut-off valve (Adjustment/Test).

C W. Before next flight operationally test fuel enrichment solenoid (Ref. 73-21-07).

C X. Close L.H. hinged cowl, 413A or 423A for engines
C No.1 and 3 (Ref. 71-11-00) or install and secure L.H.
C mid fixed panel 433CL and lower L.H. hinged cowl panel
C 433AL (Ref.71-12-03).

C NOTE: When installing mid fixed cowl; install the
C forward inboard mount bolts (2), then the forward
C outboard mount bolts (2), then the trailing edge
C bolts (7), then tighten and torque all bolts.

R HIGH PRESSURE FUEL SHUT-OFF VALVE - ADJUSTMENT/TEST

R Referenced Procedures

R 71-11-00 Cowling, Engines No.1 and No.3 - Servicing
R 71-12-01 L.H. and R.H. Lower Hinged Cowls - Servicing
R 24-41-00 External Power/Ground Service System

R 1. Operational Test

R A. Open relevant circuit breakers to isolate electrical supply to engine ignition systems.

R B. Energize ground services system (Ref. 24-41-00).

R C. Open L.H. hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL engine No.2 (Ref. 71-12-01).

R D. Select relevant FUEL AND IGNITION switch 'ON', zone 210.

R E. Observe indicator on front face of shut-off valve aligns with OPEN mark.

R F. Select FUEL AND IGNITION switch 'OFF'.

R G. Observe indicator aligns with SHUT mark.

R H. De-energize ground services system (Ref. 24-41-00).

R I. Close circuit breakers opened in operation (1).

R J. Close L.H. hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL for engine No.2 (Ref. 71-12-01).

FUEL MANIFOLD - REMOVAL/INSTALLATION

Service Bulletin referred to:

73-2903	Strengthened Manifold Support
72-5857	Repositioned Manifold Support

Referenced Procedures:

70-51-00	Torque Tightening Technique
71-00-00	Power Plant - Adjustment/Test
72-03-00	Gas Generator Fairings - Removal/Installation
73-11-09	Fuel Tubes - Maintenance Practices
78-30-00	Thrust Reverser - Servicing

Illustrated Parts Catalogue References:

The I.P.C. sections where parts disturbed during the following operations can be located are as follows:

R 73-11-11 Engine Fuel System, Fuel Manifold

1. Removal/Installation Main Fuel Manifold

A. Remove Main Fuel Manifold

(1) Equipment required:

UT630/1	Spanner wrench fuel manifold
XUT42526	Spacer
XUT42527	Side piece
289200	Protective work mat

Clean receptacle - minimum capacity:

1 U.S. gallon
1 Imperial gallon
4 Litres

(2) WARNING: ENSURE THRUST REVERSER SYSTEM IS LOCKED IN FORWARD THRUST POSITION WHILE WORK IS IN PROGRESS.
Deactivate and tag thrust reverser and associated systems, and fit thrust reverser mechanical locks (Ref. 78-30-00).

(3) On pilots centre console, zone 210, ensure appropriate FUEL AND IGNITION switch in OFF position.

(4) Position working platform or protective work mat as appropriate in cold stream duct.

(5) Remove following gas generator fairings (Ref. 72-03-00).

(a) Engines No.1 and 3

Turbine Section Lower Fairing 417A or 427A
Combustion Section L.H. Fairing 412JL or 422JL
Combustion Section R.H. Fairing 412JR or 422JR

(b) Engine No.2

Turbine Section Lower Fairing 437A
Combustion Section L.H. Fairing 432JL
Combustion Section R.H. Fairing 432JR

(6) Position clean receptacle to collect fuel spillage when manifold connectors disconnected.

(7) Refer to fig.401 (Sheet 1 or 2), using tool UT.630/1 disconnect connectors (1).

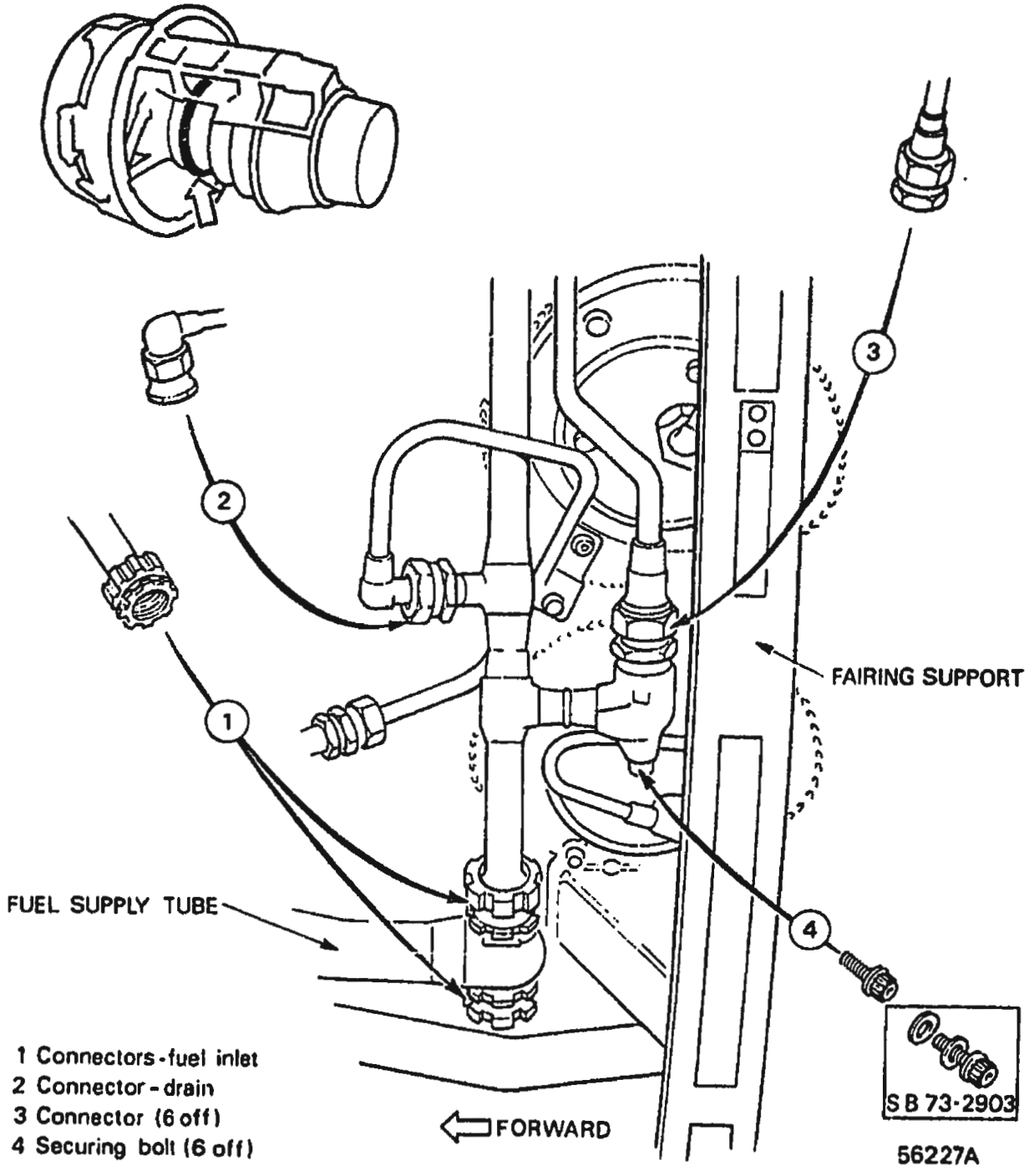
(8) Disconnect connector (2).

(9) Disconnect connector (3).

(10) Repeat operation (9) at remaining two positions on left-hand manifold and three positions on right-hand manifold.

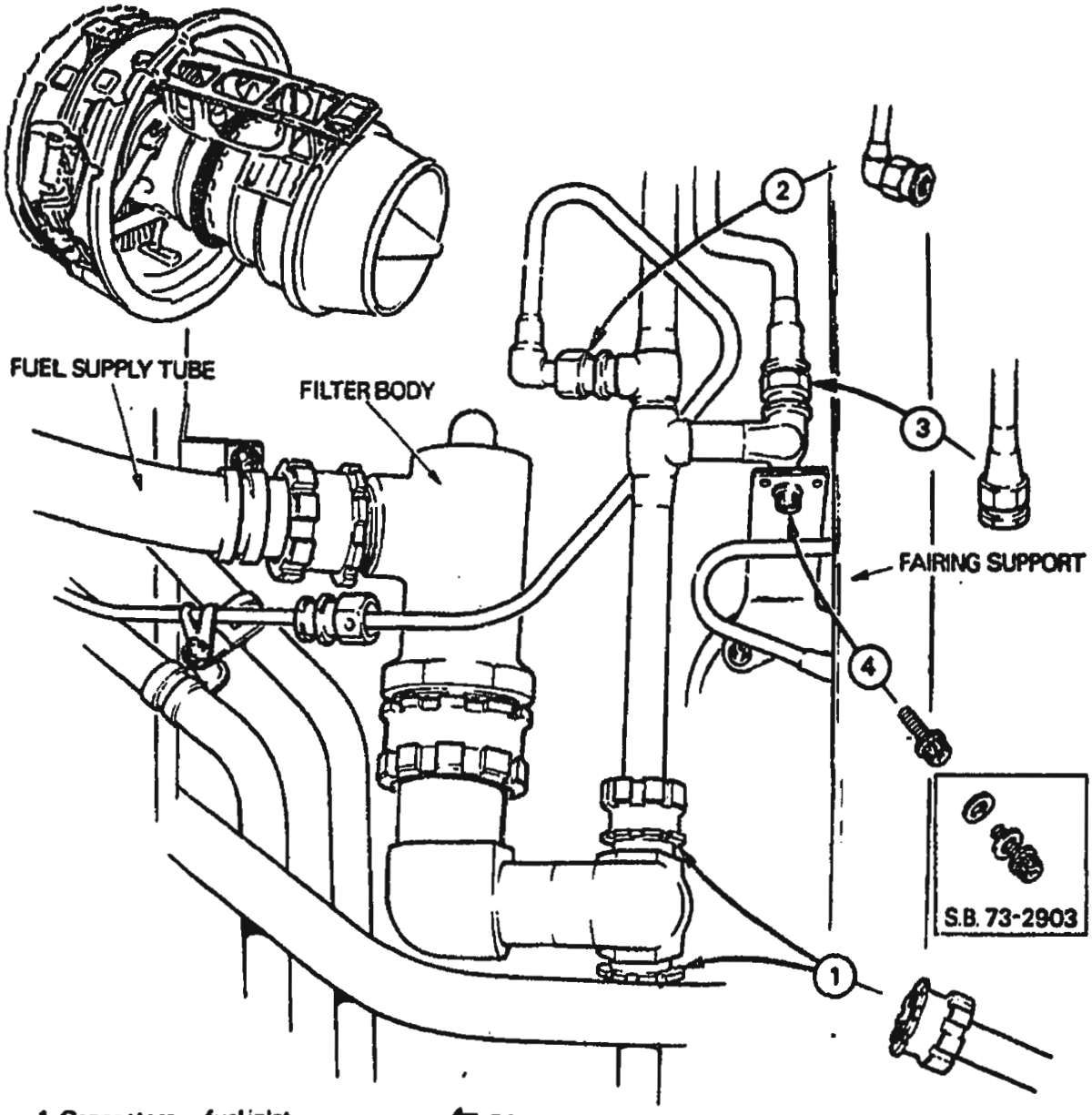
(11) Remove bolt and washer or bolt, spacer and washer (4).

(12) Repeat operation (11) at remaining two positions on left-hand manifold and three positions on right-hand manifold.



CR Main fuel manifold disconnect points -
CR Fig.401 (Sheet 1)

R EFFECTIVITY: ALL
R
050B 1A



1. Connectors — fuel inlet
2. Connector — drain
3. Connector (6 off)
4. Securing bolt (6 off)

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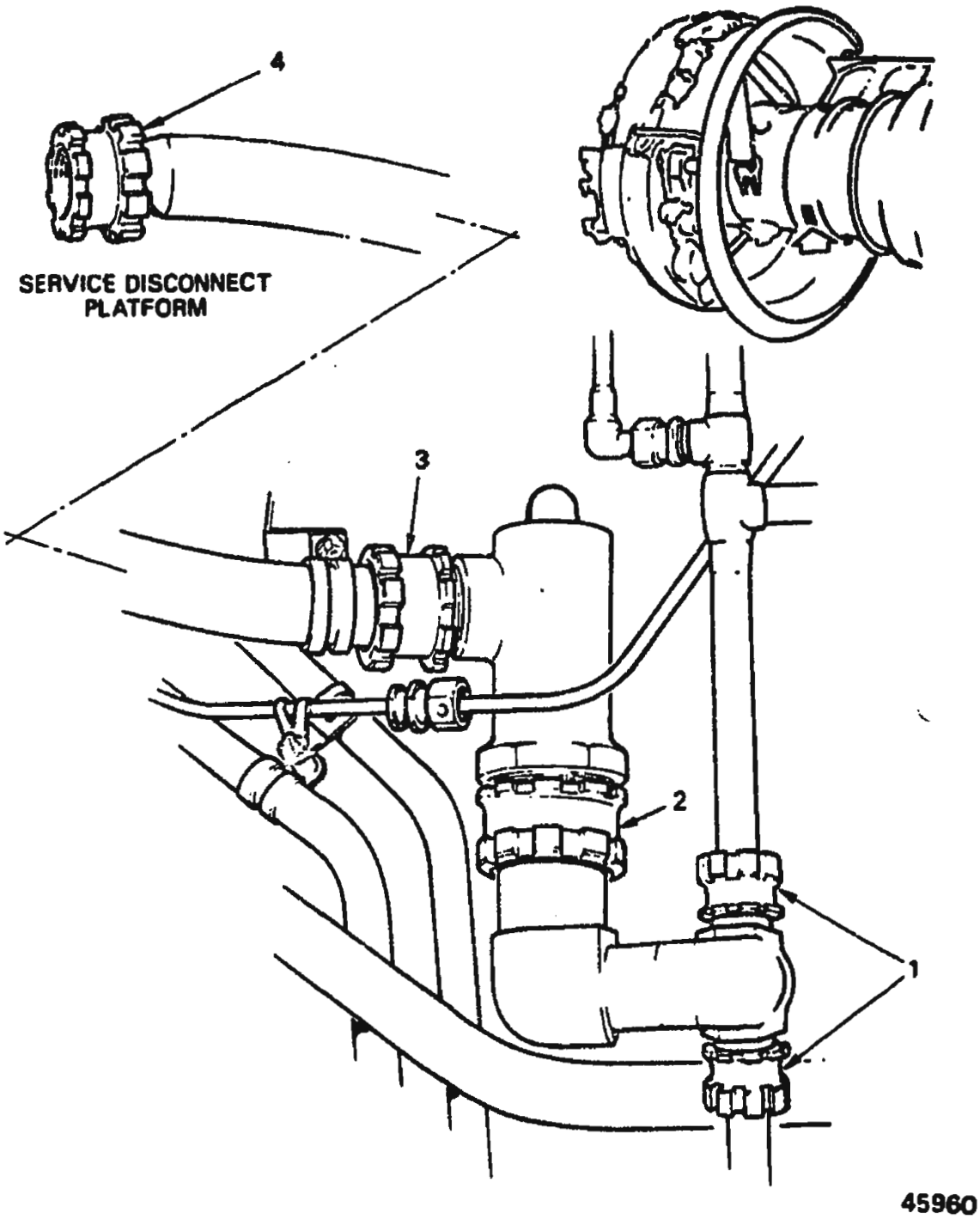
R Main fuel manifold disconnect points -
R Fig.401 (Sheet 2)



R Torque Tightening Procedure for: H.P. fuel filter,
R tubes and fittings
R Fig.401 (Sheet 3)

(13) Remove left-hand and right-hand manifolds.

(14) Fit approved blanks to all exposed connectors.

B. Install Main Fuel Manifold

(1) Equipment Required:

UT630/1	Spanner wrench
XUT42526	Spacer
XUT42527	Side piece
289200	Protective work mat
UT893	Spanner wrench filter body
UT894	Spanner wrench filter body/platform

(2) Material required:

	British Spec./Ref.	American Spec./Ref.	OMat Item No.
Lockwire	DTD.189A 22 S.W.G.	21 A.W.G.	238

(3) Ensure thrust reverser is locked and systems are deactivated and tagged as detailed in operation A.(2) and (3).

(4) Ensure working platform or protective work mat is positioned in cold stream duct.

(5) Remove blanks, if fitted, from connectors.

(6) Refer to fig.401 (Sheet 1 or 2). Position left-hand manifold adjacent to support brackets and secure with bolts (4). On engines incorporating S.B.73-2903, interpose washer between manifold and bracket, and between bracket and bolt. On engines incorporating S.B.72-5857 interpose spacer between bracket and bolt.

(7) Position right-hand manifold adjacent to support brackets and secure with bolts (4). On engines incorporating 73-2903, interpose washer between manifold and bracket, and between bracket and bolt. On engines incorporating S.B.72-5857 interpose spacer between bracket and bolt.

(8) Connect and secure (Ref. 70-51-00, Para.10) connectors (3), at six positions, and wirelock.

C (9) Connect and secure (Ref. 70-51-00, Para.10) connector
C (2), and wirelock.

C (10) Using clean engine oil, apply coating of oil on the
C 'Tee' fitting threads (1) connect and torque nuts
C to 325 inch pounds. Allow fittings to set for
C 5 minutes and re-torque to 325 inch pound. Install
C lock wire.

(11) Before next flight, test all disturbed connectors for
C leaks (Ref. 71-00-60, Adjustment/Test Table 501).

(12) Fit gas generator fairings (Ref. 72-03-00) removed in operation 1.A.(5) and remove working platform.

(13) Unlock and reactivate thrust reverser and associated systems (Ref. 78-30-00).

2. Removal/Installation Primary Fuel Tubes

Referenced Procedures:

12-12-01	Engine Oil Replenishing
71-00-00	Power Plant - Adjustment/Test
72-03-00	Gas Generator Fairings - Removal/Installation
78-30-00	Thrust Reverser - Servicing

Illustrated Parts Catalogue References:

The I.P.C. sections where parts disturbed during the following operations can be located are as follows:

R 73-11-11 Engine Fuel System, Fuel Manifolds

A. Remove Primary Fuel Tubes

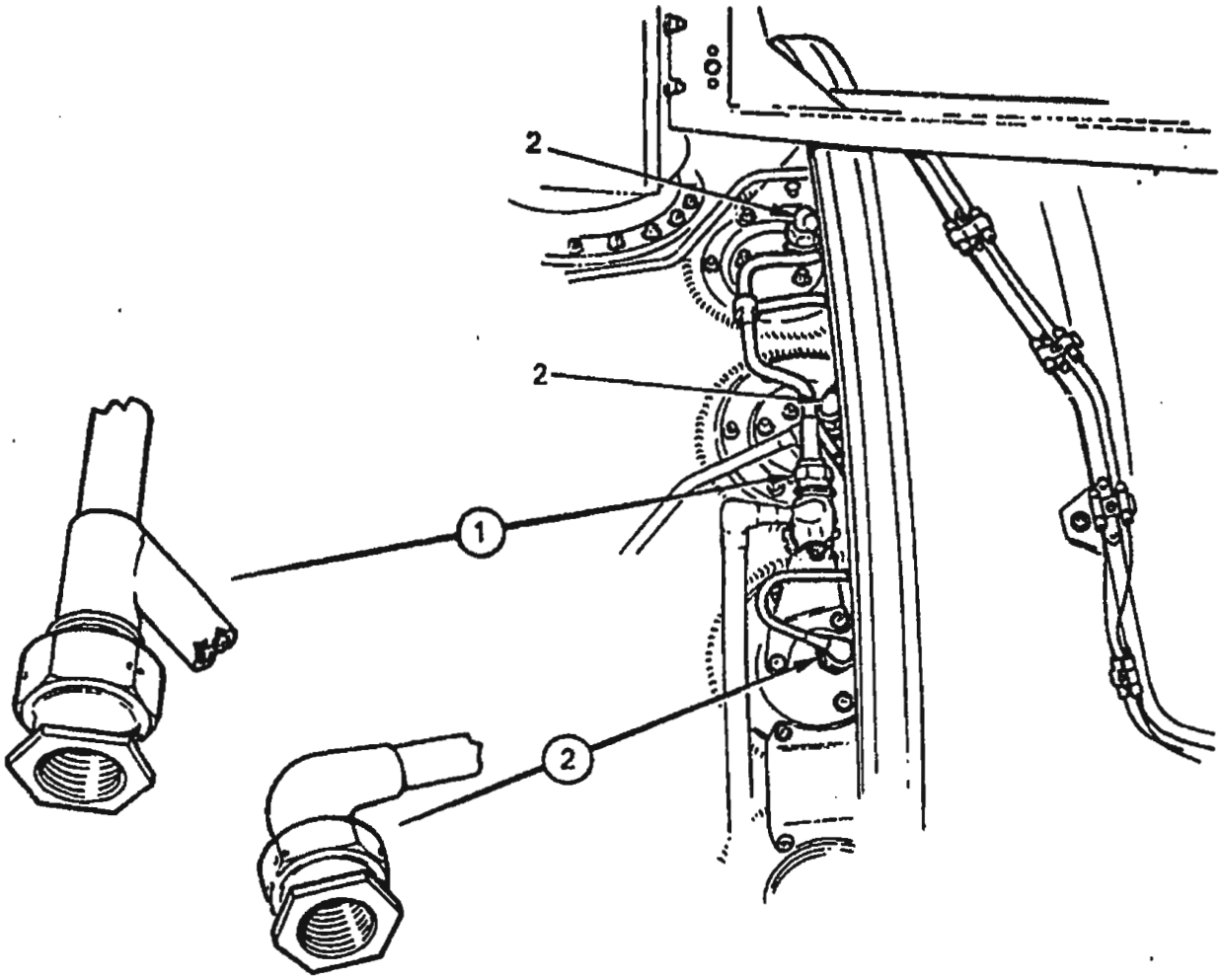
(1) Equipment Required:

XUT42526	Spacer
XUT42527	Side piece
289200	Protective work mat

Clean receptacle - minimum capacity:

1 U.S. gallon
1 Imperial gallon
4 Litres

(2) WARNING: ENSURE THRUST REVERSER IS LOCKED IN FORWARD THRUST POSITION WHILE WORK IS IN PROGRESS. Deactivate and tag thrust reverser and associated systems and fit thrust reverser mechanical locks (Ref. 78-30-00).



1 Connector - primary fuel tube to manifold
2 Connector (3 off) - primary fuel tube to spray nozzle

30634B

R Primary fuel tubes - removal/installation
R Fig.402

R EFFECTIVITY: ALL
R

(3) On pilots centre console, zone 210, ensure appropriate FUEL AND IGNITION switch in OFF position.

(4) Position working platform or protective work mat as appropriate in cold stream duct.

(5) Remove following gas generator fairings (Ref. 72-03-00).

(a) Engines No.1 and 3

Turbine Section Lower Fairing 417A or 427A
Combustion Section L.H. Fairing 412JL or 422JL
Combustion Section R.H. Fairing 412JR or 422JR.

(b) Engine No.2

Turbine Section Lower Fairing 437A
Combustion Section L.H. Fairing 432JL
Combustion Section R.H. Fairing 432JR

(6) Position clean receptacle to collect fuel spillage.

(7) Refer to fig.402, disconnect connectors (1) and (2), and remove primary fuel tube.

(8) Repeat operation (7) for remaining five primary fuel tubes.

(9) Fit approved blanks to all exposed apertures and connectors.

B. Install Primary Fuel Tubes

(1) Equipment required:

HU25937	Bar-reactor
XUT42526	Spacer
XUT42527	Side piece
289200	Protective work mat

(2) Material required:

	British Spec./Ref.	American Spec./Ref.	OMat Item No.
Lockwire	DTD.189A 22 S.W.G.	- 21 A.W.G.	238

Clean engine oil (Ref.12-12-01)

(3) Ensure thrust reverser is locked and systems are deactivated and tagged as detailed in operation A.(2) and (3).

(4) Ensure working platform or protective work mat is positioned in cold stream duct.

(5) Remove blanks, if fitted, from connectors and apertures. Lightly lubricate main manifold and primary fuel tube connector threads and sealing surfaces with engine oil.

(6) Refer to fig.402, position primary fuel tube, then run down all connectors until finger tight.

(7) Repeat operation (6) for remaining five primary fuel tubes.

(8) Tighten primary fuel tube connectors

(a) CAUTION: MANUALLY RESTRAIN PRIMARY FUEL TUBE DURING TIGHTENING SEQUENCE USING TOOL HU25937.
Torque tighten spray nozzle connectors to 195 lb.in. (22.04 Nm.).

(b) Release spray nozzle connectors.

(c) Repeat operations (a) and (b) a further two times.

(d) Finally torque tighten spray nozzle connectors to 250 lb.in. (28.24 Nm.) and wirelock.

(e) CAUTION: MANUALLY RESTRAIN PRIMARY FUEL TUBE DURING TIGHTENING SEQUENCE USING TOOL HU25937
Torque tighten main manifold connector to 195 lb.in. (22.04 Nm.).

(f) Release main manifold connector.

(g) Repeat operations (e) and (f) a further two times.

(h) Finally torque tighten main manifold connector to 250 lb.in. (28.24 Nm.) and wirelock.

(9) Repeat operations (8), (a), through (h) for remaining five primary fuel tubes.

(10) Before next flight, test all disturbed connectors for leaks (Ref. 71-00-00, Adjustment/Test Table 501).

(11) Fit gas generator fairings (Ref. 72-03-00) removed in operation 2.A.(5) and remove working platform.

(12) Unlock and reactivate thrust reverser and associated systems (Ref. 78-30-00).

R FUEL MANIFOLD - INSPECTION/CHECK

R 1. Inspection/Check

R A. Inspect Main Fuel Manifold and Primary Fuel Tubes.

R For main fuel manifold and primary fuel tubes inspection
R procedure and damage acceptance standards, refer to
R 73-11-09, Inspection/Check.

CR

FUEL SPRAY NOZZLE - MAINTENANCE PRACTICES

CR 1. Service Evaluation of Two-Piece Pintle in Fuel Spray Nozzle RB211

CR A. A new fuel spray nozzle with a two-piece pintle will be
CR service evaluated in four TWA engines. Engine number 4402,
CR the first engine with service evaluation units installed will
CR be leaving MCI approximately June 15, 1981.

CR B. The two-piece nozzle's external appearance, when installed, is
CR the same as our present nozzle. However, when the combustion
CR liner is boroscoped, the two-piece nozzle metering face will
CR appear sonewhat different.

CR C. The existing nozzle pintle is flat across the face and
CR presents a view similar to a group of concentric circles.
CR The new two-piece pintle will have a smaller inner-most
CR pintle piece with a hole through the center. A cross
CR sectional view of both metering heads along with the
CR ''boroscope view'' follows.

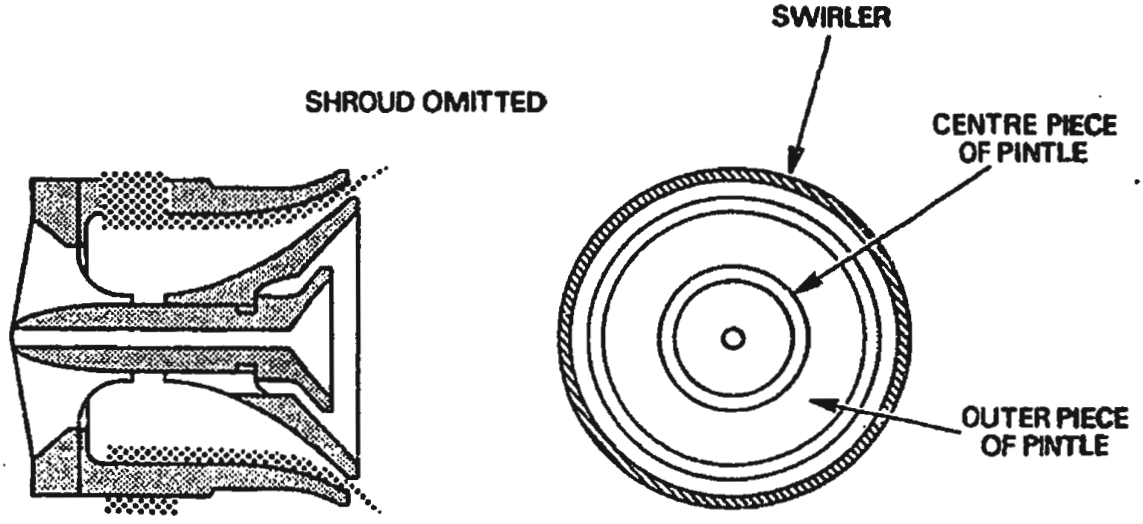
CR D. The purpose of the pintle redesign is to eliminate carbon
CR buildup on the pintle face which subsequently breaks off and
CR erodes the turbine blades.

CR E. The service evaluation fuel spray nozzles have been installed
CR as a set of 18 in all positions. They are both physically
CR and functionally interchangeable with existing nozzles. In
CR the unlikely event of a nozzle replacement in the field, a
CR standard nozzle should be installed. The removed service
CR evaluation nozzle must be returned to MCIEE for review and
CR return to Rolls Royce.

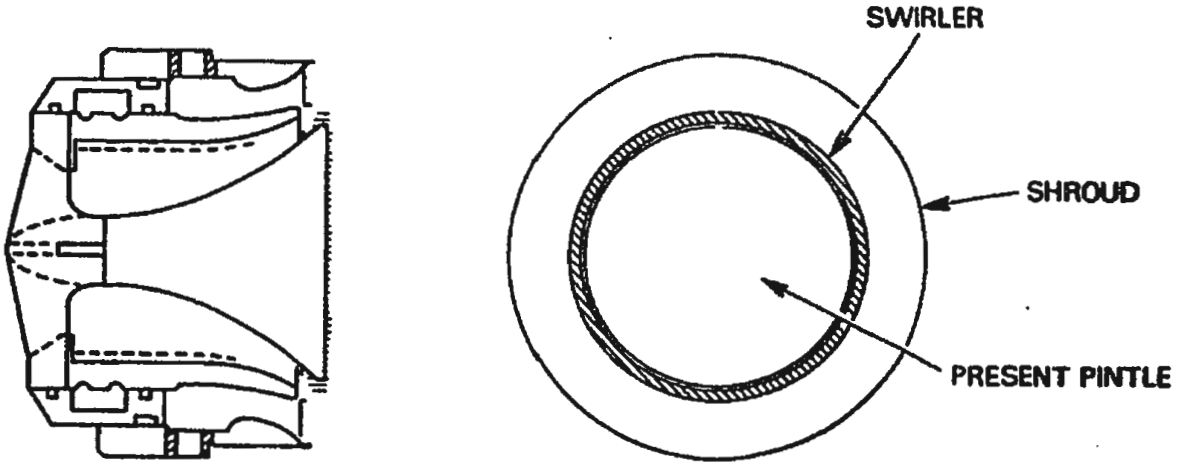
CR F. Those engines with service evaluation nozzles will receive
CR the same boroscope checks as scheduled for all other RB211
CR engines.

CR G. This will be revised when the numbers of the remaining
CR engines have been established.

CR H. The external surface of the nozzle mounting flange has been
CR painted yellow for ease of identification.



2 PIECE PINTLE
SERVICE EVALUATION CONFIGURATION



PRESENT STANDARD CONFIGURATION

65218

CR Fuel spray nozzle - service evaluation
CR Fig.201

FUEL SPRAY NOZZLE - REMOVAL/INSTALLATION

1. Removal/Installation Fuel Spray Nozzles

Service Bulletins referred to:

S.B.73-2222 - Introduction of P4 Type Spray Nozzles at No.6 Position
S.B.75-2668 - P4 Air Tube from No.3 Spray Nozzle, Simplified Run
S.B.73-2903 - Fuel Manifold Support Bracket with Increased Strength
S.B.73-2900 - Igniter Burner Feed Arms with Starter Jet Drillings Unmachined
S.B.74-2444 - Additional Clipping of Igniter Leads
S.B.73-3459 - Fuel Spray Nozzle with H.P.3 Bleed Valve P4 Tapping Replaced by Standard Type
S.B.73-4158 - Deletion of Fuel Spray Nozzle Spacer
S.B.73-3894 - Fuel Spray Nozzles - P4 Air Seal Carriers and Tubes with Increased Size Connections.
S.B.73-4532 - Inversion of Fuel Spray Nozzle Seal Ring Carrier
S.B.73-4444 - Controlled igniter protrusion into flame tube
S.B.72-5857 - Repositioning and strengthening of fuel manifold support brackets.
R S.B.73-6794 - Fuel spray nozzles - Two part deflector cones with
R increased anti-carbon airflow and inclined air
R feed hole

Referenced Procedures

70-51-00	Torque Tightening Technique
71-00-00	Power Plant - Adjustment/Test
72-00-00	Engine - Inspection/Check
72-03-00	Gas Generator Fairings - Removal/Installation
74-21-02	High Energy Igniter Plug - Removal/Installation
74-21-02	High Energy Igniter Plug - Inspection/Check
78-30-00	Thrust Reverser - Servicing

Illustrated Parts Catalogue References

The I.P.C. sections where parts disturbed during the following operations can be located are as follows:

73-11-05	Fuel Manifolds
73-11-06	Fuel Spray Nozzles

The spray nozzles are numbered clockwise viewed from rear, No.1 being to the right of top centre (Ref. 73-11-00, fig.1).

A. Remove Spray Nozzles

Incorporation of S.B.73-4158 deletes the spacer fitted under the spray nozzle. Therefore on engines incorporating this S.B. disregard reference to item 3, fig.401 and item 8, fig.402 in the following procedures.

(1) Equipment required:

CP20309 or XUT 37594	Working platform
or (XUT42526	Spacer
(XUT42527	Side piece
289200	Protective work mat

Clean receptacle - minimum capacity:

1 U.S. gallon
1 Imperial gallon
4 Litres

(2) WARNING: ENSURE THRUST REVERSER SYSTEM IS LOCKED IN FORWARD THRUST POSITION WHILE WORK IS IN PROGRESS.
Deactivate and tag thrust reverser and associated systems and fit thrust reverser mechanical locks (Ref. 78-30-00, Servicing).

(3) On pilots centre console, zone 210, ensure appropriate FUEL AND IGNITION switch in OFF position.

(4) Position working platform or protective work mat in cold stream duct.

(5) Remove gas generator combustion section fairings (Ref. 72-03-00). If removing spray nozzles No.3, 15 or 17 also remove compressor section rear fairings.

(6) Position receptacle to collect fuel spillage when lower manifold to spray nozzle tubes are removed.

(7) Remove spray nozzles No.8 or 12

(a) Remove appropriate igniter plug (Ref. 74-21-02)

(b) Refer to fig.403, remove appropriate tube (1)

(c) Refer to A, fig.403, remove bolts (2) and locking plate (13).

On engines with S.B.73-2900, also remove locking plate (13).

(d) CAUTION: WHEN WITHDRAWING SPRAY NOZZLE ENSURE SPACER IS REMOVED WITH SPRAY NOZZLE TO PREVENT SPACER (3) FALLING DOWN BETWEEN INNER AND OUTER COMBUSTION CASES.
Refer to fig.401, remove seal ring carrier assembly (1), then withdraw spray nozzle (2) with spacer (3).

(e) Fit approved blanks to all exposed apertures and connectors.

(8) Remove spray nozzles No.15 or 17.

(a) Refer to fig.403, remove appropriate tube (1)

(b) Remove bolt and washer (3) or (4) as appropriate, leave support clip on tube and igniter lead.
On engines incorporating S.B.72-2444, when removing bolt and washer (3) also remove spacer from between support clips.

(c) Remove tube (5) or (6) as appropriate.

(d) Remove bolt and washer (7) bolts (8) and locking plate.

(e) Refer to fig.401, remove cover plate (4), seals (5), split seals (6) and spacer (7).

(f) CAUTION: WHEN WITHDRAWING SPRAY NOZZLE ENSURE SPACER IS REMOVED WITH SPRAY NOZZLE TO PREVENT SPACER (3) FALLING DOWN BETWEEN INNER AND OUTER COMBUSTION CASES.
Remove seal ring carrier assembly (8), then withdraw spray nozzle (9) with spacer (3).

(g) Fit approved blanks to all exposed apertures and connectors.

(9) Remove spray nozzle No.3 (Engines not incorporating S.B.75-2668)

(a) Refer to A, fig.404, remove tube (1).

(b) Remove bolts and washers (5) bolts (6) and locking plate.

(c) Refer to fig.401, remove cover plate (4), seals (5), split seals (6) and spacer (7).

(d) CAUTION: WHEN WITHDRAWING SPRAY NOZZLE ENSURE SPACER IS REMOVED WITH SPRAY NOZZLE TO PREVENT SPACER (3) FALLING DOWN BETWEEN INNER AND OUTER COMBUSTION CASES.
Remove seal ring carrier assembly (8), then withdraw spray nozzle (9) with spacer (3).

(e) Fit approved blanks to all exposed apertures and connectors.

(10) Remove spray nozzle No.3 (Engines incorporating S.B.75-2668)

(a) Refer to B, fig.404, remove bolt and washer (2).

(b) Remove bolt and washer (3) leave support clips on tubes. On engines incorporating S.B.74-2444 remove bolt and washer (3) and spacer from between support clips.

(c) Remove tube (4).

(d) Remove bolt and washer (5) bolts (6) and locking plate.

(e) Refer to fig.401, remove cover plate (4), seals (5), split seals (6) and spacer (7).

(f) CAUTION: WHEN WITHDRAWING SPRAY NOZZLE ENSURE SPACER IS REMOVED WITH SPRAY NOZZLE TO PREVENT SPACER (3) FALLING DOWN BETWEEN INNER AND OUTER COMBUSTION CASES.
Remove seal ring carrier assembly (8), then withdraw spray nozzle (9) with spacer (3).

(g) Fit approved blanks to all exposed apertures and connectors.

(11) Remove spray nozzles No.1, 4, 7, 10, 13 or 16

(a) Refer to fig.403, remove appropriate tube (1).

(b) Remove bolt and washers or bolt, spacer and washer (9).

(c) Remove bolts (10) and locking plate.

(d) Remove bolts (11). On engines incorporating S.B.73-2903 - also remove washers.

(e) Refer to fig.401, on engines without S.B.72-5857 remove manifold support (10), remove cover plate (11). On engines with S.B.72-5857 remove cover plate (10).

(f) CAUTION: WHEN WITHDRAWING SPRAY NOZZLE ENSURE SPACER IS REMOVED WITH SPRAY NOZZLE TO PREVENT SPACER (3) FALLING DOWN BETWEEN INNER AND OUTER COMBUSTION CASES.
Remove seal ring carrier assembly (1), then withdraw spray nozzle (12) with spacer (3).
On engines with S.B.72-5857 withdraw spray nozzle (11) with spacer (3).

(g) Fit approved blanks to all exposed apertures and connectors.

(12) Remove spray nozzle No.6 (S.B.73-2222 only)

(a) Refer to fig.403, remove appropriate tube (1).

(b) Remove bolt and washer (7) and bolts (8).

(c) Refer to fig.402, remove blanking nut (1), cover plate (2), seals (3), split seals (4) and spacer (5).

(d) CAUTION : WHEN WITHDRAWING SPRAY NOZZLE, ENSURE SPACER IS REMOVED WITH SPRAY NOZZLE TO PREVENT SPACER (8) FALLING DOWN BETWEEN INNER AND OUTER COMBUSTION CASES.
Remove seal ring carrier assembly (6) then withdraw spray nozzle (7) with spacer (8).

(13) Remove spray nozzles No.2, 5, 9, 11, 14 or 18 and spray nozzle No.6 (Pre S.B.73-2222 or S.B.73-3459).

(a) Refer to fig.403, remove appropriate tube (1).

(b) Remove bolts (12) and locking plate.

(c) CAUTION: WHEN WITHDRAWING SPRAY NOZZLE ENSURE SPACER IS REMOVED WITH SPRAY NOZZLE TO PREVENT SPACER (3) FALLING DOWN BETWEEN INNER AND OUTER COMBUSTION CASES.
Refer to fig.401, remove cover plate (11) and seal ring carrier assembly (1), then withdraw spray nozzle (12) with spacer (3).

(d) Fit approved blanks to all exposed apertures and connectors.

B. Install Spray Nozzles

R CAUTION: FUEL SPRAY NOZZLES INCORPORATING S.B.73-6794 ARE
R SUPPLIED AS ENGINE SETS AND MUST NOT BE INTERMIXED
R WITH PRE S.B.72-6794 FUEL SPRAY NOZZLES

Incorporation of S.B.73-4158 deletes the spacer fitted under the spray nozzle. Therefore on engines incorporating this S.B. disregard reference to item 3, fig.401 and item 8, fig.402 in the following procedures.

(1) Equipment required:

HU25937	Bar-reactor
CP20309 or XUT37594	Working platform
or (XUT42526	Spacer
(XUT42527	Side piece
289200	Protective work mat
Small soft bristled brush	

(2) Material required:

	British Spec./Ref	American Spec./Ref	OMat Item No.
Jointing compound	DTD.900/4586 (Hylomar light)	-	4/46

	British Spec./Ref	American Spec./Ref	OMat Item No.
Petroleum jelly	DEF.2333 PX.6, PX.7	- VV-P-236	402
Degreasing fluid	B.S.1940 1968	-	135
Methylethylketone (M.E.K.) or Acetone	B.S. 509: 1964	-	150
or Methylene Chloride (Dichloromethane)	B.S.1994: 1953	-	169
Lockwire	DTD.189A 22 S.W.G.	- 21 A.W.G.	238

Clean engine oil (Ref.12-12-01)

(3) Ensure thrust reverser is locked and systems are deactivated and tagged as detailed in operation 2.A.(2).

(4) Ensure working platform or protective work mat is positioned in cold stream duct.

(5) Remove blanks, if fitted, from connectors and spray nozzle apertures.

(6) WARNING : WHEN USING DEGREASING FLUID, ENSURE ADEQUATE VENTILATION AND AVOID SKIN CONTACT AND INHALING THE VAPOUR.

CAUTION : CARE MUST BE TAKEN WHEN APPLYING THE SOLVENT AS THE SURFACE PROTECTION WILL BE AFFECTED. ANY AFFECTED AREAS MUST BE REPROTECTED IN ACCORDANCE WITH 70-42-12.

Refer to fig.401 and 402, using cold liquid degrease remove jointing compound from spacers (3) and (7) and allow to dry.

(7) Difficulty may be experienced in correctly locating the upper spray nozzles (No.1, 2, 3, 16, 17 and 18) due to the combustion chamber mini-flares moving out of central position. The mini-flares can be temporarily held in the central position by applying a smear of petroleum jelly through the spray nozzle location bore.

(8) Install spray nozzles No.8 or 12

(a) Refer to fig.401, inspect spacer (3) for nicks, cracks, or bending, if apparent renew spacer.

(b) Apply a thin film of jointing compound to one side of spacer and to mating surface on underside flange of spray nozzle (2).

(c) Allow a short period of time for jointing compound to become tacky then fit spacer to spray nozzle flange ensuring holes are correctly aligned.

(d) Insert spray nozzle (2) into spray nozzle location bore and locate head in miniflare bore.

(e) CAUTION: ENSURE SPRAY NOZZLE IS CORRECTLY LOCATED IN MINIFLARE BORE. REF.PARA.C.

(f) CAUTION: THE SEAL RING CARRIER ASSEMBLY MUST BE FITTED IN THE COMBUSTION CASE SPRAY NOZZLE LOCATION BORE IN THE CORRECT ATTITUDE, REF.FIG.401.

Refer to fig.401, with the riveted seal ring retaining plate outermost, slide seal ring carrier assembly (1) over spray nozzle (2) and locate in combustion case bore. Push seal ring carrier assembly fully home and align bolt holes with spray nozzle bolt holes.

(g) Refer to A, fig.403, secure carrier and spray nozzle with bolts (2) ensuring correct spray nozzle location is maintained.

On engines with S.B.73-2900, interpose locking plate (13) under rear, left bolt.

(h) Lightly lubricate tube (1) connector threads and sealing surfaces with engine oil.

(j) Fit tube (1) to spray nozzles and manifold; run down all connectors until finger tight.

(k) CAUTION: MANUALLY RESTRAIN TUBE (1) DURING TIGHTENING SEQUENCE USING TOOL HU25937.
Torque tighten fuel spray nozzle connectors, to approximately 195 lbs.ins. (22.04 Nm.).

(m) Release spray nozzle connectors.

(n) Repeat operations (k) and (m) a further two times.

(p) Finally torque tighten fuel spray nozzle connectors, to 250 lbs.ins. (28.24 Nm.), and and wirelock to locking plate (13).

(q) CAUTION: MANUALLY RESTRAIN TUBE (1) DURING TIGHTENING SEQUENCE USING TOOL HU25937.
Torque tighten manifold connector, to approximately 195 lbs.ins. (22.04 Nm.).

(r) Release manifold connector.

(s) Repeat operations (q) and (r) a further two times.

(t) Finally torque tighten manifold connector, to 250 lbs.ins. (28.24 Nm.), and wirelock.

(u) On engines with S.B.73-4444, check igniter immersion (Ref. 74-21-02, Inspection/Check).

(v) Fit appropriate igniter plug (Ref. 74-21-02).

(9) Install spray nozzles No.15 or 17

(a) Refer to fig.401, inspect spacer (3) for nicks, cracks or bending, if apparent renew spacer.

(b) Apply a thin film of jointing compound to one side of spacer and to mating surface on underside of flange of spray nozzle (9).

(c) Allow a short period of time for jointing compound to become tacky then fit spacer to spray nozzle flange ensuring holes are correctly aligned.

(d) Insert spray nozzle (9) into spray nozzle location bore and locate head in miniflare bore.

(e) CAUTION: ENSURE SPRAY NOZZLE IS CORRECTLY LOCATED IN MINIFLARE BORE. REF.PARA.C.

(f) Fit seal ring carrier assembly (8) into spray nozzle location bore ensuring positive location with P4 air orifice in spray nozzle flange and spacer (3).

(g) Fit spacer (7), split seals (6), seal (5) and cover plate (4) in order shown.

(h) Refer to fig.403, secure cover plate with bolt and washer (7).

(j) Secure assembly with bolts (8) ensuring correct spray nozzle location is maintained. Interpose locking plate under rear, left bolt.

(k) Fit and secure (Ref. 70-51-00) air tube (5) or (6) as appropriate and wirelock connectors. Secure tube and igniter lead support clips to bracket with bolt and washer (3) or (4) as appropriate. On engines incorporating S.B.74-2444, interpose spacer between support clips when fitting bolt and washer (3).

(m) Lightly lubricate tube (1) connector threads and sealing surfaces with engine oil.

(n) CAUTION: AT NO.15 AND 17 FUEL SPRAY NOZZLE POSITIONS, ENSURE THAT FUEL TUBE (1) IS CONNECTED TO FUEL SPRAY NOZZLE REARMOST CONNECTOR (FUEL) AND NOT FOREMOST CONNECTOR (P4 AIR).
Fit fuel tube (1) to spray nozzles and manifold; run down all connectors until finger tight.

NOTE: On engines with S.B.73-3894, the seal ring carrier assembly P4 air connector is larger in diameter than the fuel connector.

(p) CAUTION: MANUALLY RESTRAIN TUBE (1) DURING TIGHTENING SEQUENCE USING TOOL HU25937.
Torque tighten fuel spray nozzle connectors, to approximately 195 lbs.ins. (22.04 Nm.).

(q) Release spray nozzle connectors.

(r) Repeat operations (p) and (q) a further two times.

(s) Finally torque tighten fuel spray nozzle connectors, to 250 lbs.ins. (28.24 Nm.), and wirelock to locking plate.

(t) CAUTION: MANUALLY RESTRAIN TUBE (1) DURING TIGHTENING SEQUENCE USING TOOL HU25937.
Torque tighten manifold connector, to approximately 195 lbs.ins. (22.04 Nm.).

(u) Release manifold connector.

(v) Repeat operations (t) and (u) a further two times.

(w) Finally torque tighten manifold connector, to 250 lbs.ins. (28.24 Nm.), and wirelock.

(10) Install spray nozzle No.3 (Engines not incorporating S.B.75-2668)

(a) Refer to fig.401, inspect spacer (3) for nicks, cracks or bending, if apparent renew spacer.

(b) Apply a thin film of jointing compound to one side of spacer and to mating surface on underside of flange of spray nozzle (9).

(c) Allow a short period of time for jointing compound to become tacky then fit spacer to spray nozzle flange ensuring holes are correctly aligned.

(d) Insert spray nozzle (9) into spray nozzle location bore and locate head in miniflare bore.

(e) CAUTION: ENSURE SPRAY NOZZLE IS CORRECTLY LOCATED IN MINIFLARE BORE. REF.PARA.C.

(f) Fit seal ring carrier assembly (8) into spray nozzle location bore ensuring positive location with P4 air orifice in spray nozzle flange and spacer (3).

(g) Fit spacer (7), split seals (6), seal (5) and cover plate (4) in order shown.

(h) Refer to A, fig.404, secure cover plate with bolt and washer (5).

(j) Secure assembly with bolts (6) ensuring correct spray nozzle location is maintained. Interpose locking plate under rear, left bolt.

(k) Refer to fig.403, lightly lubricate fuel tube (1) connector threads and sealing surfaces with engine oil.

(m) CAUTION: AT NO.3 FUEL SPRAY NOZZLE POSITION, ENSURE THAT FUEL TUBE (1) IS CONNECTED TO FUEL SPRAY NOZZLE REARMOST CONNECTOR (FUEL) AND NOT FOREMOST CONNECTOR (P4 AIR).
Fit fuel tube (1) to spray nozzles and manifold; run down all connectors until finger tight.

NOTE: On engines with S.B.73-3894, the seal ring carrier assembly P4 air connector is larger in diameter than the fuel connector.

(n) CAUTION: MANUALLY RESTRAIN TUBE (1) DURING TIGHTENING SEQUENCE USING TOOL HU25937.
Torque tighten fuel spray nozzle connectors, to approximately 195 lbs.ins. (22.04 Nm.).

(p) Release fuel spray nozzle connectors.

(q) Repeat operations (n) and (p) a further two times.

(r) Finally torque tighten fuel spray nozzle connectors, to 250 lbs.ins. (28.24 Nm.), and wirelock to locking plate.

(s) CAUTION: MANUALLY RESTRAIN TUBE (1) DURING TIGHTENING SEQUENCE USING TOOL HU25937.
Torque tighten manifold connector, to approximately 195 lbs.ins. (22.04 Nm.).

(t) Release manifold connector.

(u) Repeat operations (s) and (t) a further two times.

(v) Finally torque tighten manifold connector to, 250 lbs.ins. (28.24 Nm.), and wirelock.

(w) Refer to A, fig.404, fit and secure (Ref. 70-51-00) air tube (1) and wirelock connectors.

(11) Install spray nozzle No.3 (Engines incorporating S.B.75-2668)

(a) Refer to fig.401, inspect spacer (3) for nicks, cracks or bending, if apparent renew spacer.

(b) Apply a thin film of jointing compound to one side of spacer and to mating surface on underside of flange of spray nozzle (9).

(c) Allow a short period of time for jointing compound to become tacky then fit spacer to spray nozzle flange ensuring holes are correctly aligned.

(d) Insert spray nozzle (9) into spray nozzle location bore and locate head in miniflare bore.

(e) CAUTION: ENSURE SPRAY NOZZLE IS CORRECTLY LOCATED IN MINIFLARE BORE. REF.PARA.C.

(f) Fit seal ring carrier assembly (8) into spray nozzle location bore ensuring positive location with P4 air orifice in spray nozzle flange and spacer (3).

(g) Fit spacer (7), split seals (6), seal (5) and cover plate (4) in order shown.

(h) Refer to A, fig.404, secure cover plate with bolt and washer (5).

(j) Secure assembly with bolts (6) ensuring correct spray nozzle location is maintained. Interpose locking plate under rear, left bolt.

(k) Refer to fig.403, lightly lubricate fuel tube (1) connector threads and sealing surfaces with engine oil.

(m) CAUTION: AT NO.3 FUEL SPRAY NOZZLE POSITION, ENSURE THAT FUEL TUBE (1) IS CONNECTED TO FUEL SPRAY NOZZLE REARMOST CONNECTOR (FUEL) AND NOT FOREMOST CONNECTOR (P4 AIR).
Fit fuel tube (1) to spray nozzles and manifold; run down all connectors until finger tight.

NOTE: On engines with S.B.73-3894, the seal ring carrier assembly P4 air connector is larger in diameter than the fuel connector.

(n) CAUTION: MANUALLY RESTRAIN TUBE (1) DURING TIGHTENING SEQUENCE USING TOOL HU25937.
Torque tighten fuel spray nozzle connectors, to approximately 195 lbs.ins. (22.04 Nm.).

(p) Release fuel spray nozzle connectors.

(q) Repeat operations (n) and (p) a further two times.

(r) Finally torque tighten fuel spray nozzle connectors, to 250 lbs.ins. (28.24 Nm.), and wirelock to locking plate.

(s) CAUTION: MANUALLY RESTRAIN TUBE (1) DURING TIGHTENING SEQUENCE USING TOOL HU25937.
Torque tighten manifold connector, to approximately 195 lbs.ins. (22.04 Nm.).

(t) Release manifold connector.

(u) Repeat operations (s) and (t) a further two times.

(v) Finally torque tighten manifold connector, to 250 lbs.ins. (28.24 Nm.), and wirelock.

(w) Refer to B, fig.404, fit and secure (Ref. 70-51-00) tube (4) and wirelock connectors.

(x) Secure tube support clips to bracket with bolt and washer (2).

(y) Secure tube support clips to bracket with bolt and washer (3). On engines incorporating S.B.74-2444, secure tube and igniter lead support clips to bracket with bolt and washer (3) interposing spacer between tube support clips and igniter lead support clip.

(12) Install spray nozzles No.1, 4, 7, 10, 13 or 16

(a) Refer to fig.401, inspect spacer (3) for nicks, cracks or bending, if apparent renew.

(b) Apply a thin film of jointing compound to one side of spacer and to mating surface on underside of flange of spray nozzle (12), on engines with S.B.72-5857 spray nozzle (11).

(c) Allow a short period of time for jointing compound to become tacky then fit spacer to spray nozzle flange ensuring holes are correctly aligned.

(d) Insert spray nozzle (12), on engines with S.B.72-5857 spray nozzle (11), into spray nozzle location bore and locate head into miniflares bore.

(e) CAUTION: ENSURE SPRAY NOZZLE IS CORRECTLY LOCATED IN MINIFLARE BORE. REF.PARA.C.

(f) CAUTION: THE SEAL RING CARRIER ASSEMBLY MUST BE FITTED IN THE COMBUSTION CASE SPRAY NOZZLE LOCATION BORE IN THE CORRECT ATTITUDE, REF.FIG.401.

Refer to fig.401, with the riveted seal ring retaining plate outermost, slide seal ring carrier assembly (1) followed by cover plate (11) over spray nozzle (12) and locate in combustion case bore. On engines with S.B.72-5857 slide seal ring carrier assembly (1) followed by cover plate (10) over spray nozzle (11) and locate in combustion case bore. Push seal ring carrier assembly and cover plate fully home and align bolt holes with spray nozzle bolt holes.

(g) On engines without S.B.72-5857 position manifold support (10) on cover plate (11).

(h) Refer to fig.403, secure manifold support, cover plate, seal ring carrier assembly and spray nozzle with bolts (10) and (11) ensuring correct spray nozzle location is maintained. Interpose locking plate under bolt (10). On engines incorporating S.B.73-2903 - interpose washers under bolt (11).

(j) Secure manifold support to manifold with bolt (9). On engines incorporating S.B.73-2903 - interpose washers between distributor valve and manifold support and between manifold support and bolt (9). On engines incorporating S.B.72-5857 interpose spacer between manifold support and bolt (9).

(k) Lightly lubricate tube (l) connector threads and sealing surfaces with engine oil.

(m) Fit tube (1) to spray nozzles and manifold; run down all connectors until finger tight.

(n) CAUTION: MANUALLY RESTRAIN TUBE (1) DURING TIGHTENING SEQUENCE USING TOOL HU25937.
Torque tighten fuel spray nozzle connectors, to approximately 195 lbs.ins. (22.04 Nm.).

(p) Release fuel spray nozzle connectors.

(q) Repeat operations (n) and (p) a further two times.

(r) Finally torque tighten fuel spray nozzle connectors, to 250 lbs.ins. (28.24 Nm.), and wirelock to locking plate.

(s) CAUTION: MANUALLY RESTRAIN TUBE (1) DURING TIGHTENING SEQUENCE USING TOOL HU25937.
Torque tighten manifold connector, to approximately 195 lbs.ins. (22.04 Nm.).

(t) Release manifold connector.

(u) Repeat operations (s) and (t) a further two times.

(v) Finally torque tighten manifold connector, to 250 lbs.ins. (28.24 Nm.), and wirelock.

(13) Install spray nozzle No.6 (S.B.73-2222 only)

(a) Refer to fig.402, inspect spacer (8) for nicks, cracks or bending, if apparent renew spacer.

(b) Apply a thin film of jointing compound to one side of spacer and to mating surface on underside of flange of spray nozzle (7).

(c) Allow a short period of time for jointing compound to become tacky then fit spacer to spray nozzle flange ensuring holes are correctly aligned.

(d) Insert spray nozzle (7) into spray nozzle location bore and locate head in miniflare bore.

(e) CAUTION: ENSURE SPRAY NOZZLE IS CORRECTLY LOCATED IN MINIFLARE BORE. REF.PARA.C.

(f) Fit seal ring carrier assembly (6) into spray nozzle location bore ensuring positive location with P4 air orifice in spray nozzle flange.

(g) Fit spacer (5), split seals (4), seal (3), cover plate (2) and blanking nut (1) in order shown.

(h) Refer to fig.403, secure cover plate with bolt and washer (7).

(j) Secure assembly with bolts (8) ensuring correct spray nozzle location is maintained. Interpose locking plate under rear, left bolt.

(k) Lightly lubricate tube (1) connector threads and sealing surfaces with engine oil.

(m) Fit tube (1) to spray nozzles and manifold; run down all connectors until finger tight.

(n) CAUTION: MANUALLY RESTRAIN TUBE (1) DURING TIGHTENING SEQUENCE USING TOOL HU25937.
Torque tighten fuel spray nozzle connectors to approximately 195 lbs.ins. (22.04 Nm.).

(p) Release fuel spray nozzle connectors.

(q) Repeat operations (n) and (p) a further two times.

(r) Finally torque tighten fuel spray nozzle connectors, to 250 lbs.ins. (28.24 Nm.), and wirelock to locking plate.

(s) CAUTION: MANUALLY RESTRAIN TUBE (1) DURING TIGHTENING SEQUENCE USING TOOL HU25937.
Torque tighten manifold connector, to approximately 195 lbs.ins. (22.04 Nm.).

(t) Release manifold connector.

(u) Repeat operations (s) and (t) a further two times.

(v) Finally torque tighten manifold connectors to 250 lbs.ins. (28.24 Nm.), and wirelock.

(14) Install spray nozzles No.2, 5, 9, 11, 14 or 18 and spray nozzle No.6 (Pre S.B.73-2222 or S.B.73-3459).

(a) Refer to fig.401, inspect spacer (3) for nicks cracks or bending, if apparent renew spacer.

(b) Apply a thin film of jointing compound to one side of spacer and to mating surface on underside flange of spray nozzle (12).

(c) Allow a short period of time for jointing compound to become tacky then fit spacer to spray nozzle flange ensuring holes are correctly aligned.

(d) Insert spray nozzle (12) into spray nozzle location bore and locate head in miniflare bore.

(e) CAUTION: ENSURE SPRAY NOZZLE IS CORRECTLY LOCATED IN MINIFLARE BORE. REF.PARA.C.

(f) CAUTION: THE SEAL RING CARRIER ASSEMBLY MUST BE FITTED IN THE COMBUSTION CASE SPRAY NOZZLE LOCATION BORE IN THE CORRECT ATTITUDE, REF.FIG.401.

Refer to fig.401, with the riveted seal ring retaining plate outermost, slide seal ring carrier assembly (1) followed by cover plate (11) over spray nozzle (2) and locate in combustion case bore. Push seal ring carrier assembly and cover plate fully home and align bolt holes with spray nozzle bolt holes.

(g) Refer to fig.403, secure cover plate, seal ring carrier assembly and spray nozzle with bolts (12) ensuring correct spray nozzle location is maintained. Interpose locking plate under rear, left bolt.

(h) Lightly lubricate tube (1) connector threads and sealing surfaces with engine oil.

(j) Fit tube (1) to spray nozzles and manifold; run down all connectors until finger tight.

(k) CAUTION: MANUALLY RESTRAIN TUBE (1) DURING TIGHTENING SEQUENCE USING TOOL HU25937.

Torque tighten fuel spray nozzle connectors, to approximately 195 lbs.ins. (22.04 Nm.).

(m) Release fuel spray nozzle connectors.

(n) Repeat operations (k) and (m) a further two times.

(p) Finally torque tighten fuel spray nozzle connectors, to 250 lbs.ins. (28.24 Nm.), and wirelock to locking plate.

(q) CAUTION: MANUALLY RESTRAIN TUBE (1) DURING TIGHTENING SEQUENCE USING TOOL HU25937.
Torque tighten manifold connector, to approximately 195 lbs.ins. (22.04 Nm.).

(r) Release manifold connector.

(s) Repeat operations (q) and (r) a further two times.

(t) Finally torque tighten manifold connector, to 250 lbs.ins. (28.24 Nm.), and wirelock.

(15) Fit combustion section fairings and compressor section rear fairings (Ref. 72-03-00).

(16) Remove working platform or protective working mat from cold stream duct.

(17) Unlock and reactivate thrust reverser and associated systems (Ref. 78-30-00, Servicing).

(18) Before next flight, test all disturbed connectors for leaks (Ref. 71-00-00, Table 501).

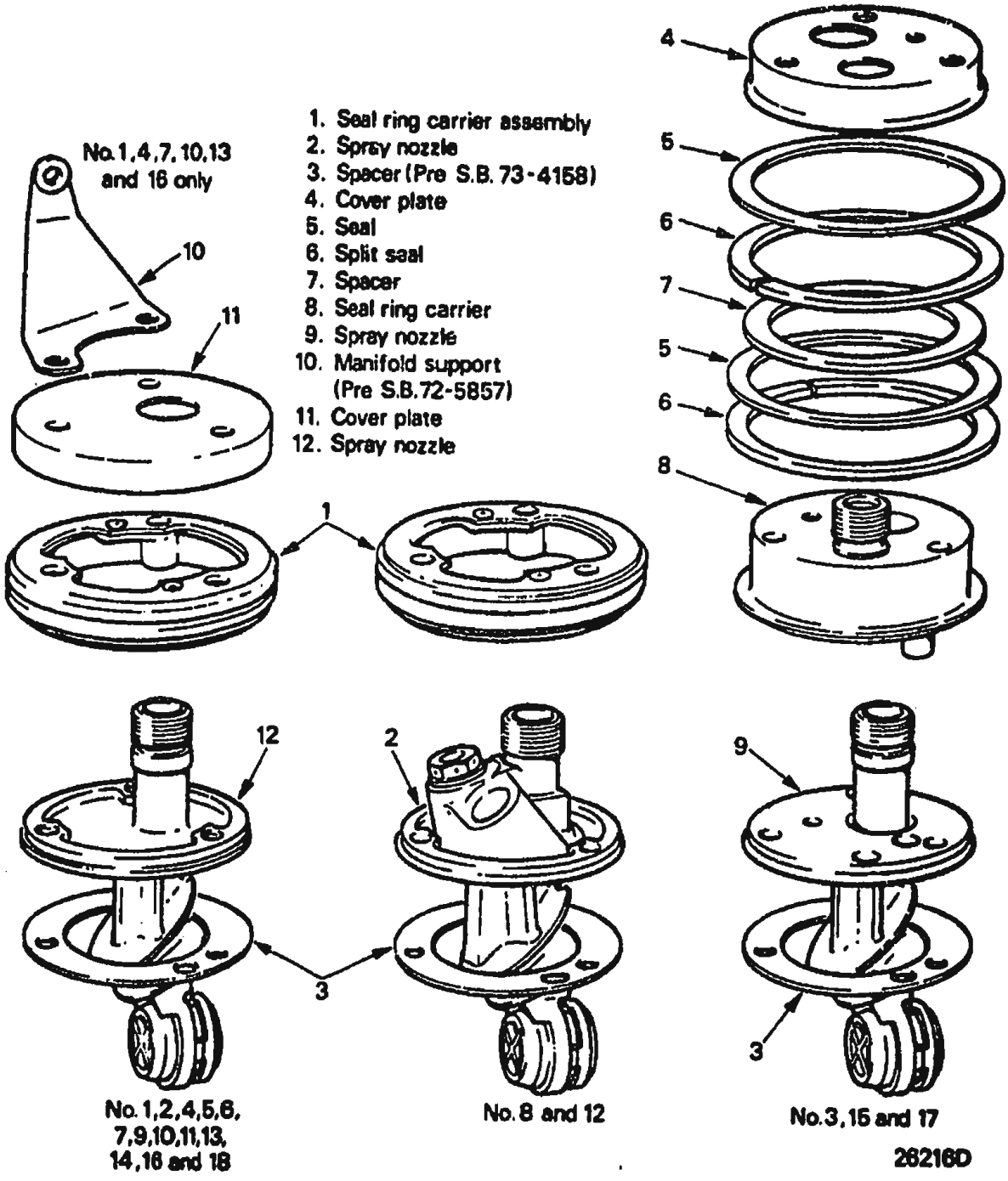
C. Check Fuel Spray Nozzles for Correct Location

(1) Remove appropriate boroscope blanking plugs and using boroscope equipment (Ref. 72-00-00), check each fuel spray nozzle for correct location as follows:

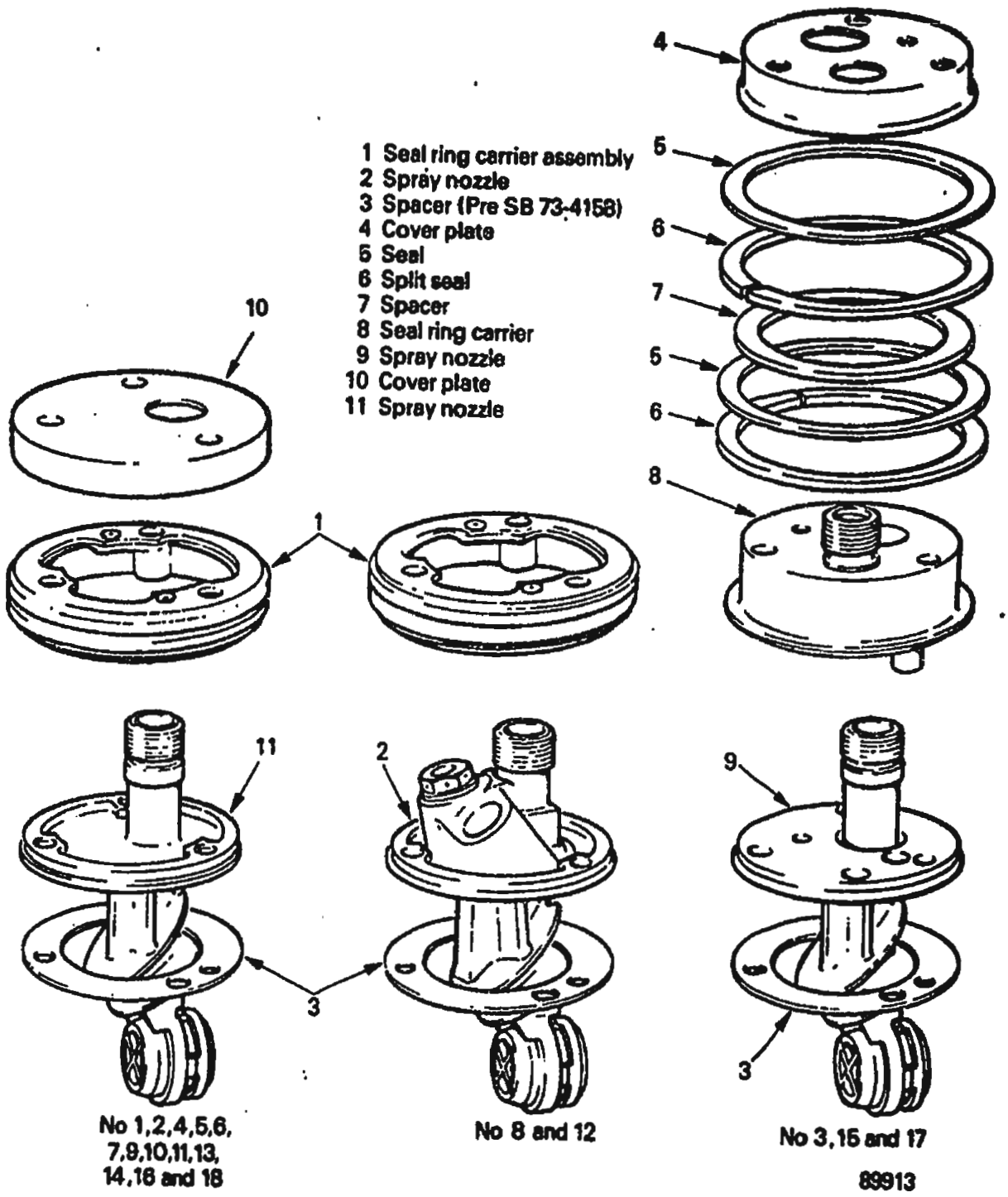
(a) Fuel spray nozzles in-line with boroscope access ports, check that fuel spray nozzle shroud ring is concentric with miniflare bore.

(b) Fuel spray nozzles not in-line with boroscope access ports, check from access ports either side that fuel spray nozzle shroud ring is concentric with miniflare bore.

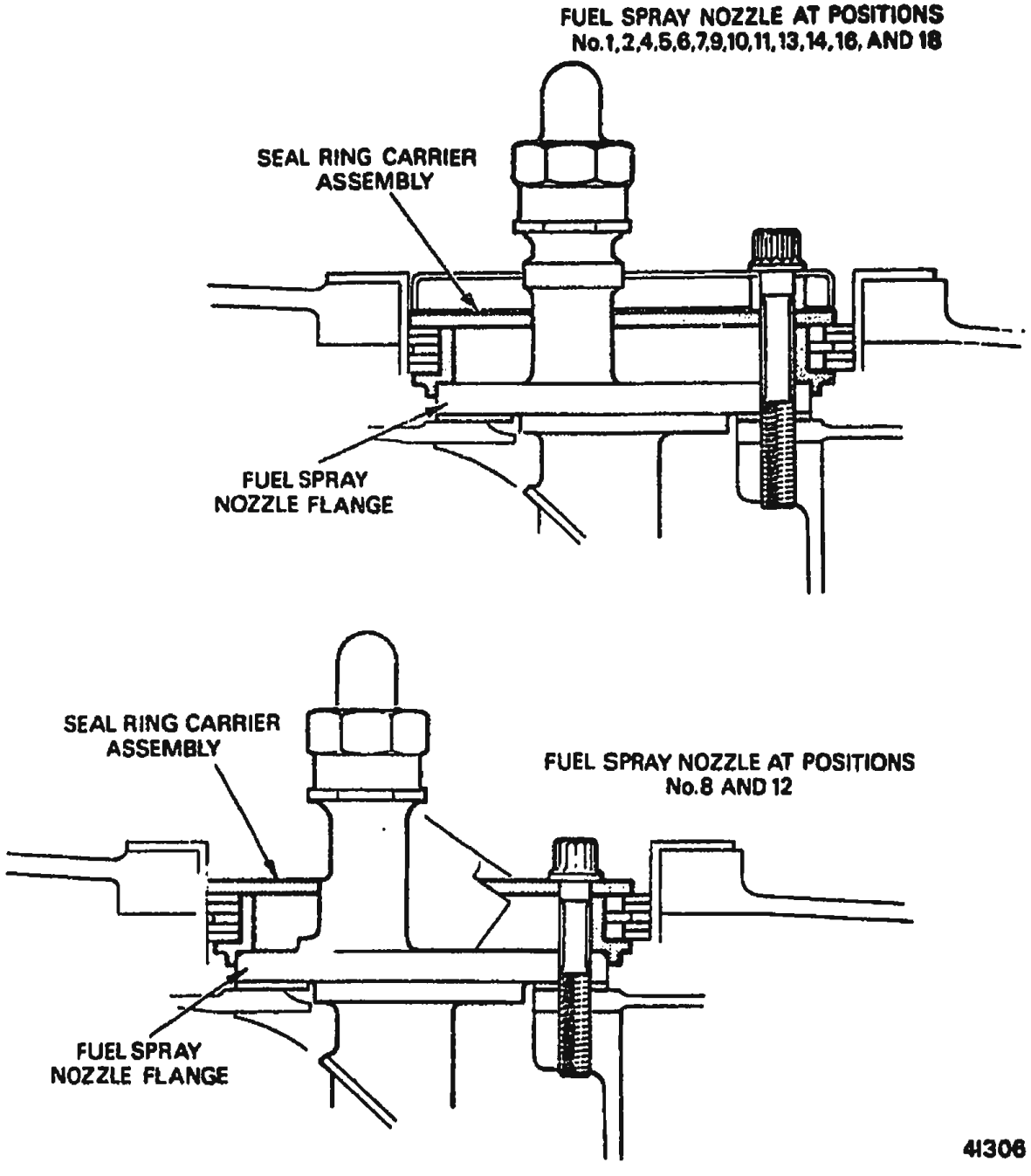
NOTE: The fuel spray nozzle is correctly located when the shroud ring penetrates the miniflare bore by a minimum of 2/3.



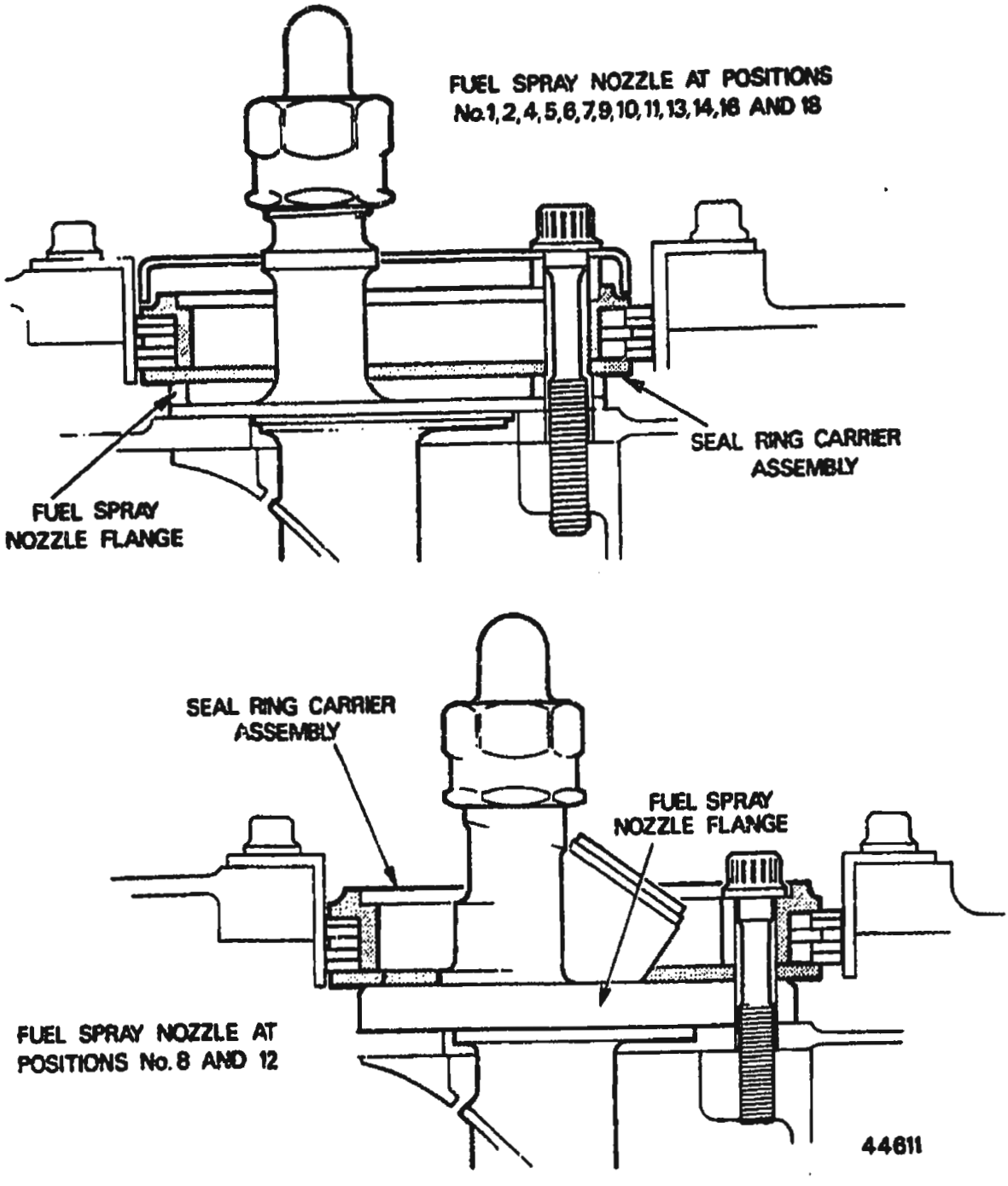
Fuel spray nozzle removal/installation (Engines without S.B.72-5857)
Fig.401 (Sheet 1)



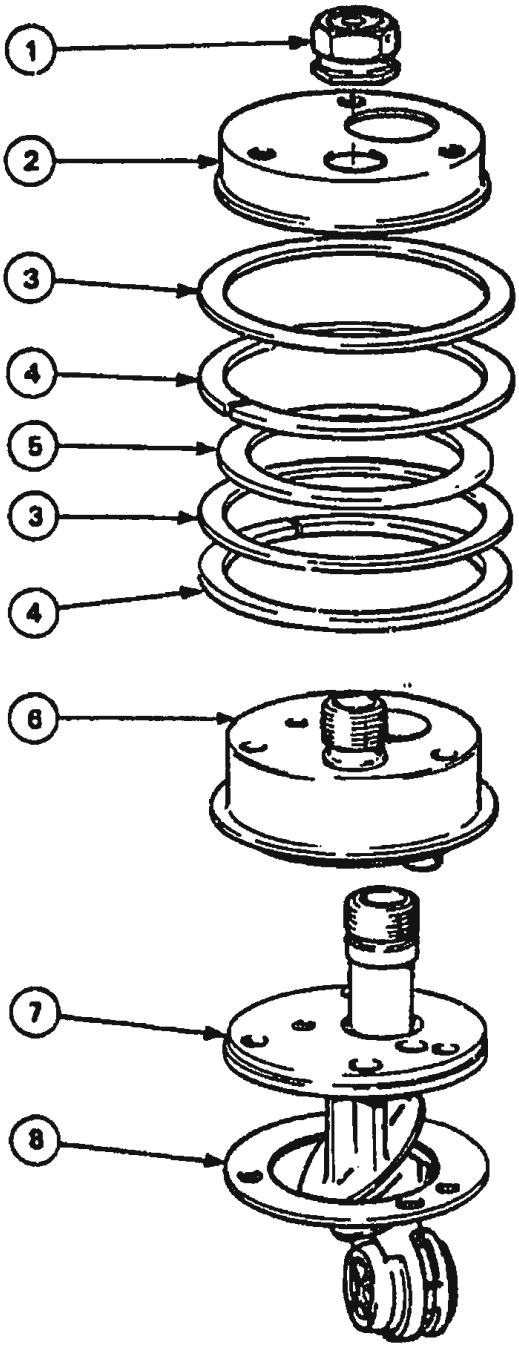
Fuel spray nozzle removal/installation (Engines with S.B.72-5857)
Fig.401 (Sheet 2)



Fitting seal ring carrier assembly - engine without S.B.73-4532
Fig.401 (Sheet 3)


FUEL SPRAY NOZZLE AT POSITIONS
No.1,2,4,5,6,7,9,10,11,13,14,16 AND 18
SEAL RING CARRIER ASSEMBLY
FUEL SPRAY NOZZLE FLANGE
SEAL RING CARRIER ASSEMBLY
FUEL SPRAY NOZZLE FLANGE
FUEL SPRAY NOZZLE AT POSITIONS No.8 AND 12
44611

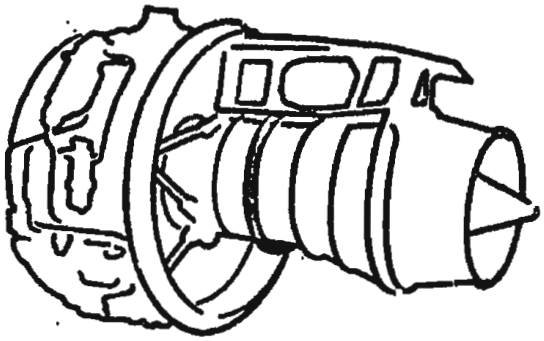
Fitting seal ring carrier assembly - engines with S.B.73-4532
Fig.401 (Sheet 4)

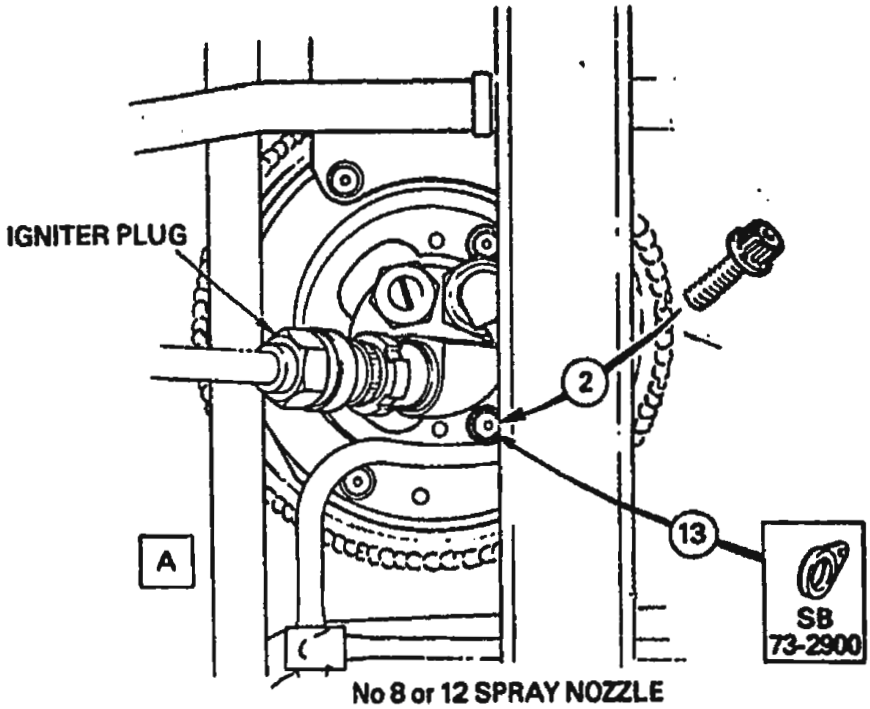


1. Blanking nut
2. Cover plate
3. Seal
4. Split seal
5. Spacer
6. Seal ring carrier
7. Spray nozzle
8. Spacer (Pre S.B.73-4158)

299638

Fuel spray nozzle No.6 removal/installation (S.B.73-2222)
Fig.402



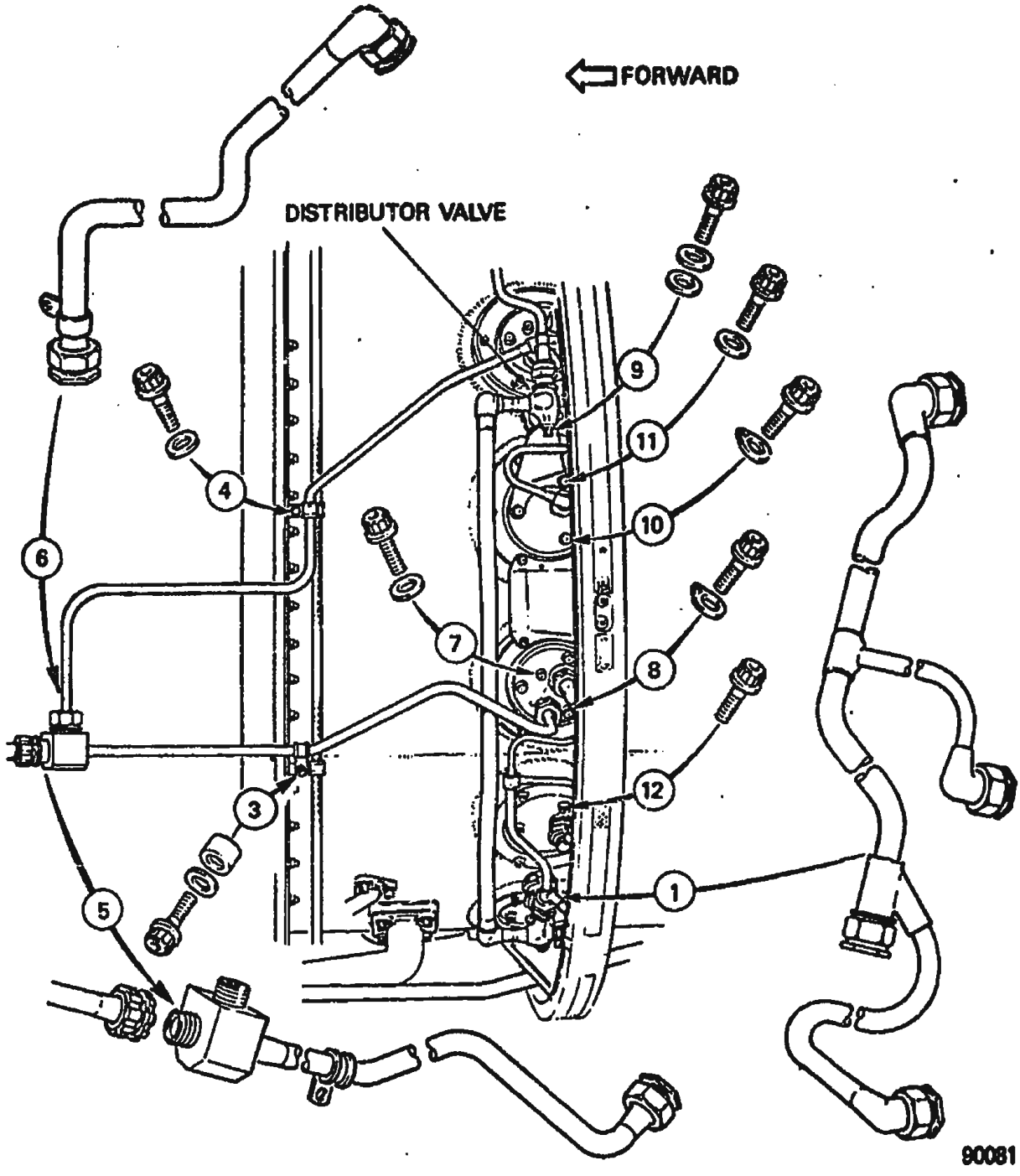


No 8 or 12 SPRAY NOZZLE

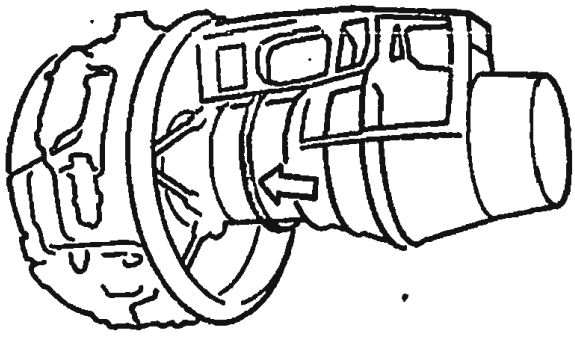
1 Tube-manifold to spray nozzles (6 off)
2 Securing bolts (3 off per nozzle)
3 Support clip securing bolt and washer (and spacer SB 74-2444)
4 Support clip securing bolt and washer
5 Air tube
6 Air tube
7 Cover plate securing bolt and washer
8 Securing bolt (3 off per nozzle) and lug (1 off per nozzle)
9 Securing bolt (and washers SB 73-2903)
10 Securing bolt and lug (1 off per nozzle)
11 Securing bolt (and washer SB 73-2903) (2 off per nozzle)
12 Securing bolt (3 off per nozzle)
13 Locking plate

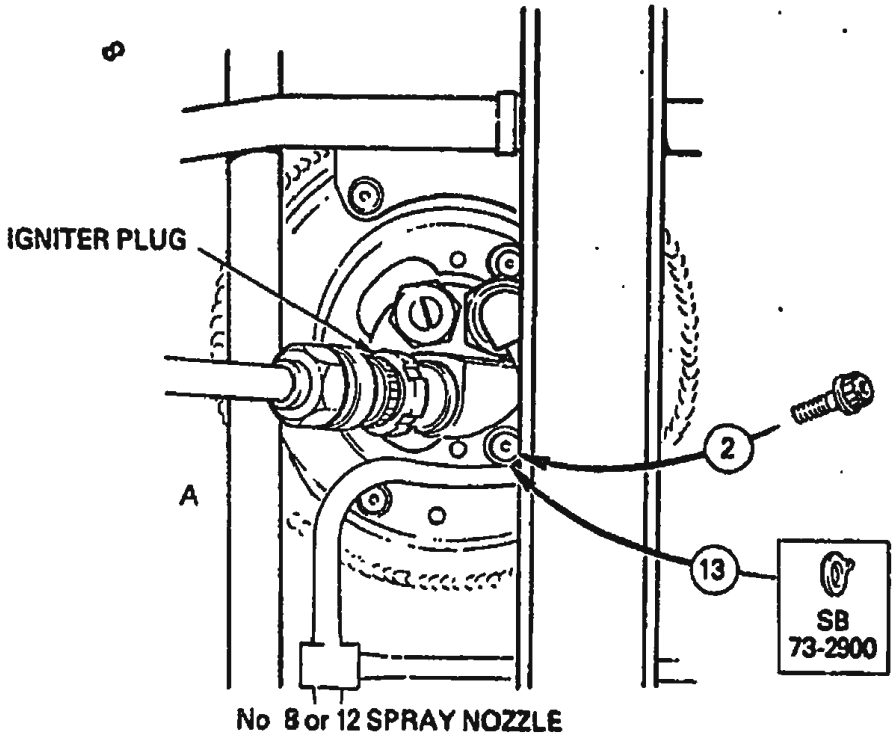
90080

Fuel spray nozzle disconnect points (Engines without S.B.72-5857)
Fig.403 (Sheet 1)



Fuel spray nozzle disconnect points (Engines without S.B.72-5857)
Fig.403 (Sheet 2)

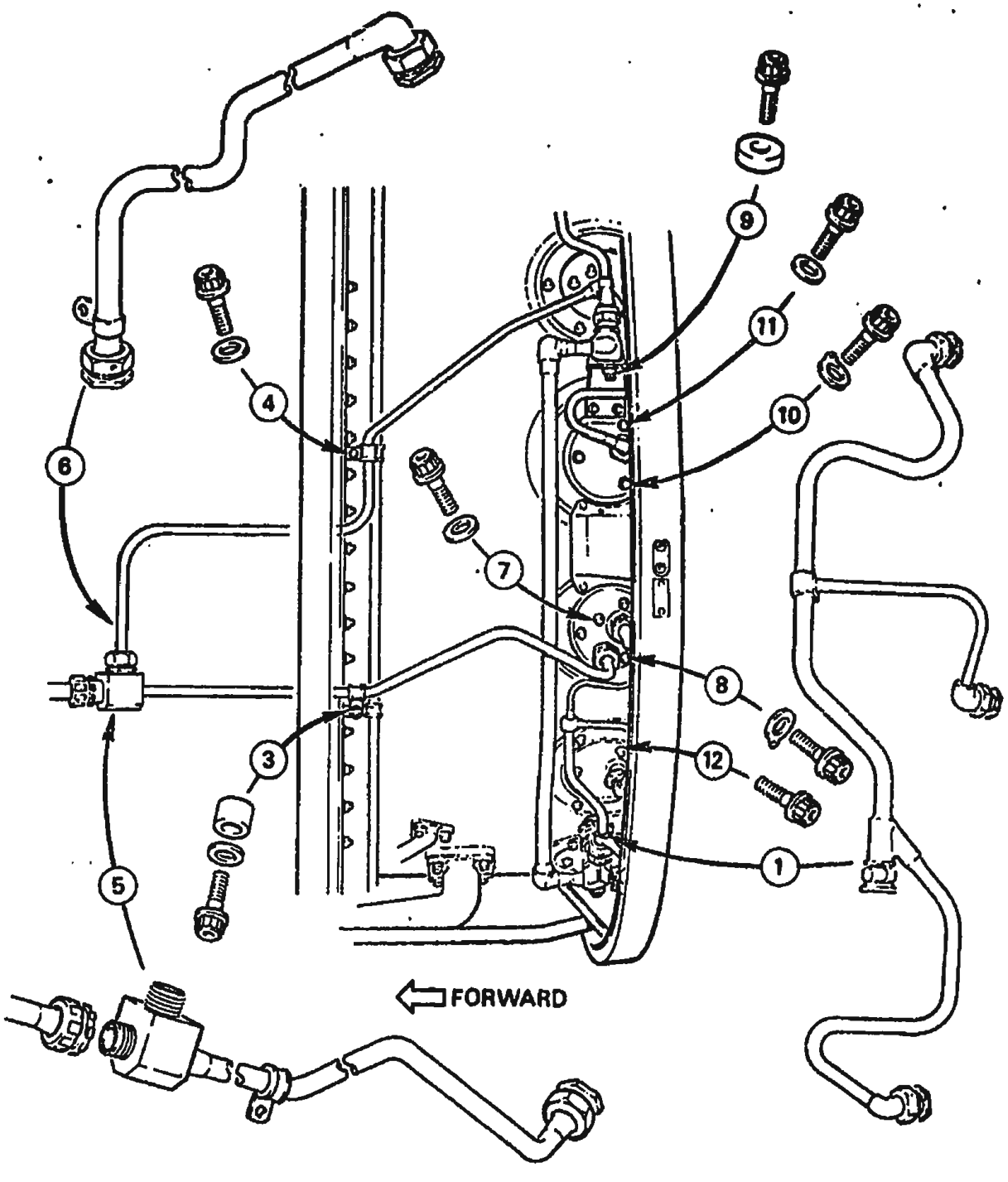




1 Tube-manifold to spray nozzles (6 off)
2 Securing bolts (3 off per nozzle)
3 Support clip securing bolt and washer (and spacer SB 74-2444)
4 Support clip securing bolt and washer
5 Air tube
6 Air tube
7 Cover plate securing bolt and washer
8 Securing bolt (3 off per nozzle)
9 Securing bolt and spacer
10 Securing bolt
11 Securing bolt (and washers SB 73-2903)(2 off per nozzle)
12 Securing bolt (3 off per nozzle)
13 Locking plate

89914

Fuel spray nozzle disconnect points (Engines with S.B.72-5857)
Fig.403 (Sheet 3)



Fuel spray nozzle disonnect points (Engines with S.B.72-5857)
Fig.403 (Sheet 4)

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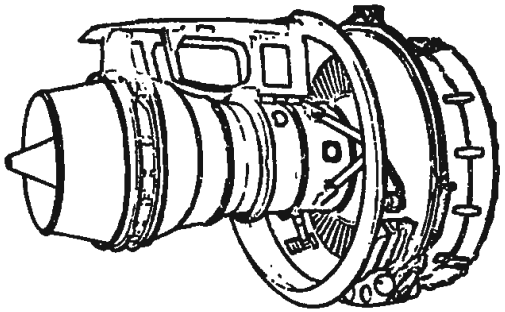
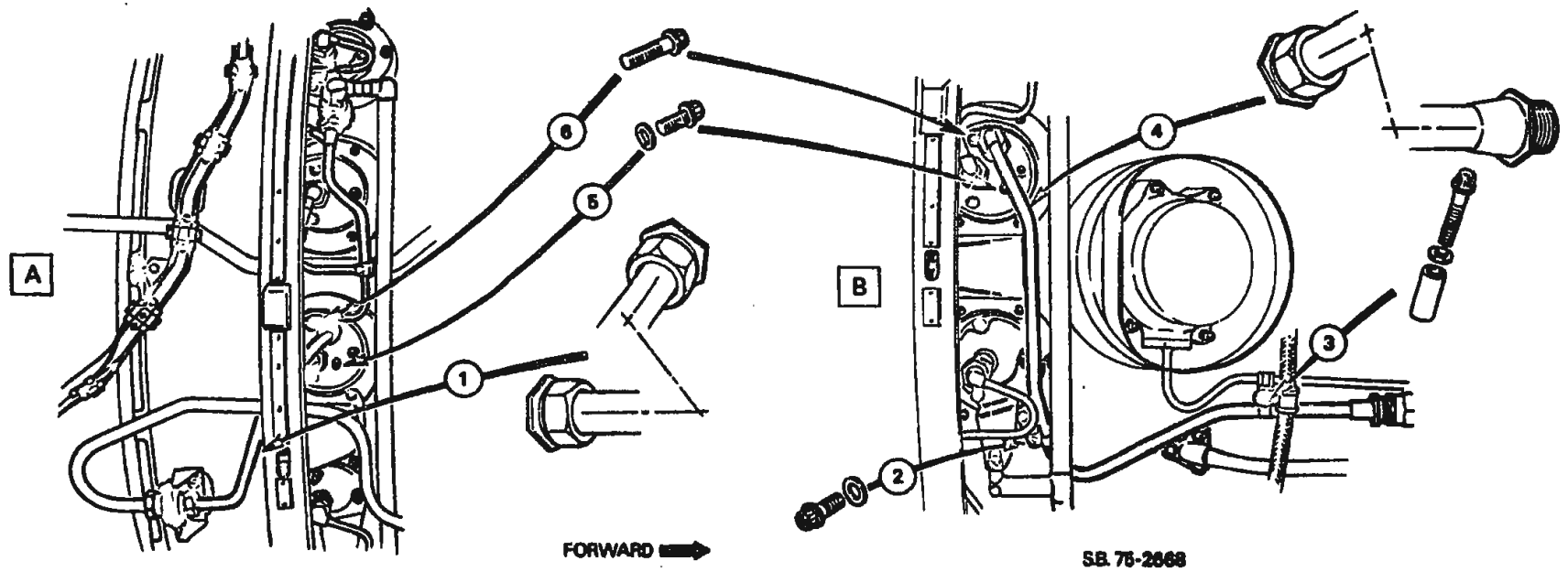
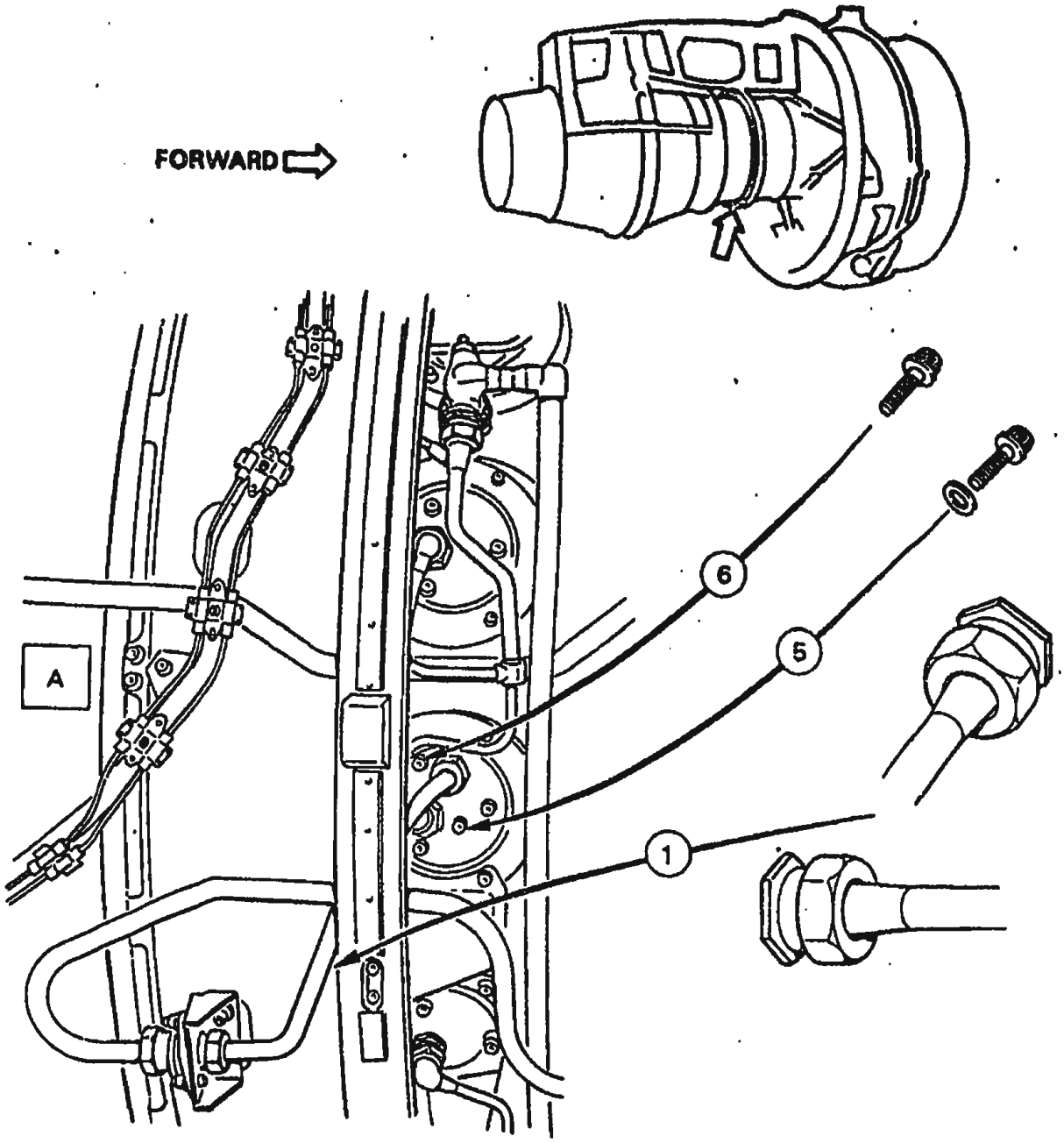


1. Air tube
2. Support clip securing bolt and washer
3. Support clip securing bolt and washer (and spacer S.B.74-2444)
4. Air tube (S.B.75-2668)
5. Cover plate securing bolt and washer
6. Securing bolts (3 off)



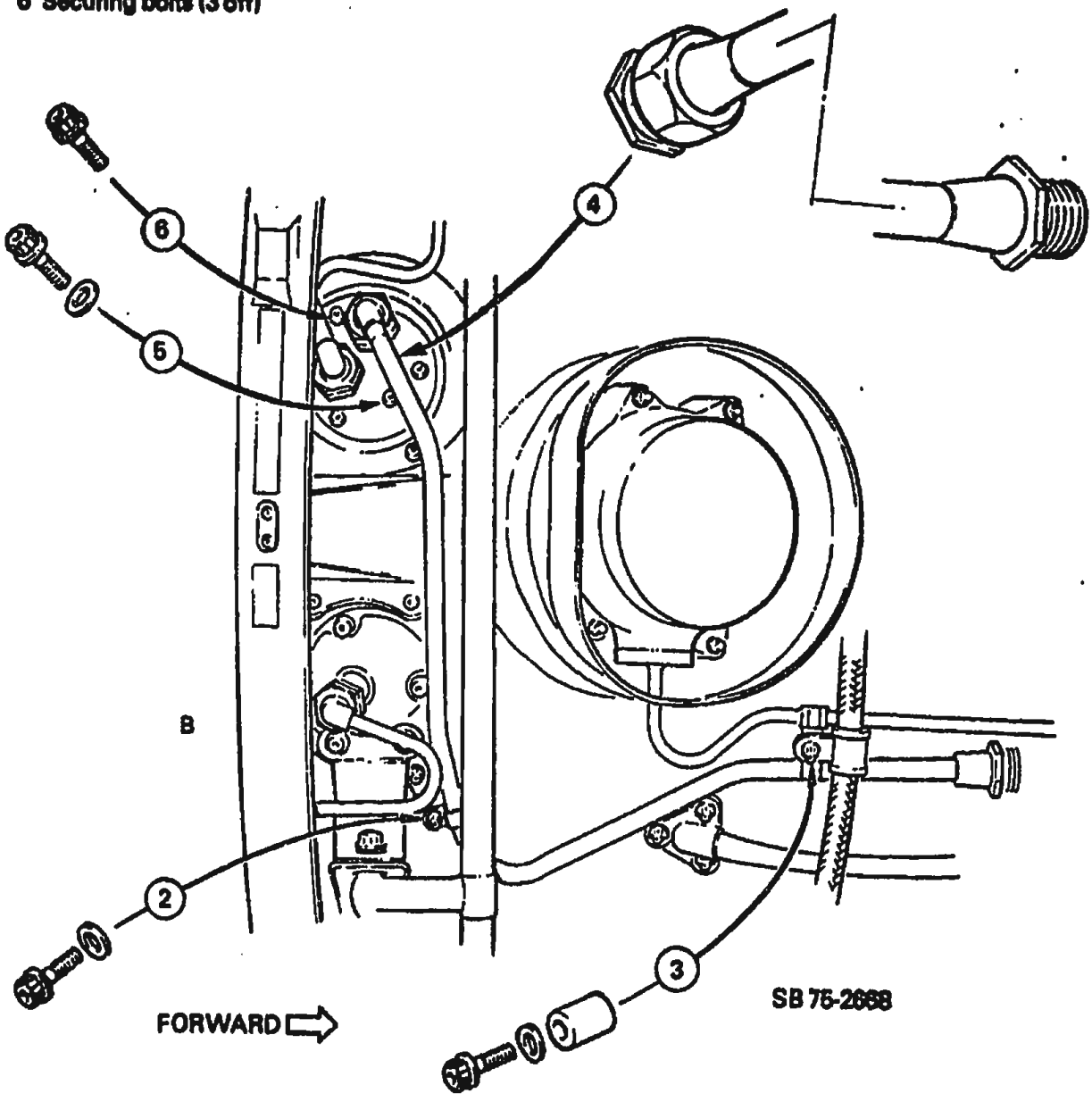
30121A

Fuel spray nozzle No.3 disconnect points (Engines without S.B.72-5857)
Fig.404 (Sheet 1)



Fuel spray nozzle No.3 disconnect points (Engines with S.B.72-5857)
Fig.404 (Sheet 2)

1 Air tube
2 Support clip securing bolt and washer
3 Support clip securing bolt and washer (and spacer SB 74-2444)
4 Air tube (SB 75-2663)
5 Cover plate securing bolt and washer
6 Securing bolts (3 off)



89917

Fuel spray nozzle No.3 disconnect points (Engines with S.B.72-5857)
Fig.404 (Sheet 3)

FUEL SPRAY NOZZLE - INSPECTION/CHECK

R 1. General

A. Referenced Procedures:

72-00-00	Engine - Inspection/Check
72-03-00	Combustion Section L.H. and R.H. Upper Fairings - Removal/Installation
73-11-06	Fuel Spray Nozzles - Removal/Installation
78-30-00	Thrust Reverser - Servicing

B. Illustrated Parts Catalogue References:

The I.P.C. sections where parts disturbed during the following operations can be located are as follows:

72-40-03	Blanking Plugs (Endoscope Access)
73-11-06	Fuel Spray Nozzles

C. Service Bulletins referred to:

73-6794	Fuel Spray Nozzles - Two Part Deflector Cone with Increased Anti-Carbon Airflow and Inclined Air Feed Hole

D. Equipment required:

289200 or C 4G 4342	Protective work mats
XUT.42526	Spacer
XUT.42527	Side piece
1702275	Endoprobe (PA/1 Ø11-V90-380-MAPV ch.30 degrees)
Small, clean brush	

E. Material required:

	British Spec./Ref.	American Spec./Ref.	OMat Item No.
Degreasing fluid (Inhibited and stabilized 1.1.1. trichloroethane)	B.S.4487: 1969	Mil-T-81533	1/21
Dry film lubricant	PL.198	-	4/20
or			
Dry film lubricant	-	Electrofilm 77/S	4/43E
Lockwire	DTD.189A 22 S.W.G.	-	238
		21 A.W.G.	

F. WARNING: ENSURE THRUST REVERSER SYSTEM IS LOCKED IN FORWARD THRUST POSITION WHILE WORK IS IN PROGRESS.
Deactivate and tag thrust reverser and associated systems and fit thrust reverser locks (Ref. 78-30-00).

G. Position spacer and side pieces or protective work mats in cold stream duct.

NOTE: Spacer and side pieces are required in cold stream duct for blanking plug positions 2, 4, 14 and 16; work mats are required in cold stream duct for blanking plug positions, 6, 8, 10 and 12.

H. Remove following gas generator fairings (Ref. 72-03-00)

(1) Engines No.1 and 3

Combustion section L.H. fairings 412JL, 422JL
Combustion section R.H. fairings 412JR, 422JR

(2) Engine No.2

Combustion section L.H. fairing 432JL
Combustion section R.H. fairing 432JR
Combustion section upper fairing

J. Assemble inspection equipment (Ref. 72-00-00).

2. Inspect Installed Fuel Spray Nozzles

A. Refer fig.601, remove bolts (1) and withdraw blanking plugs (2) from combustion outer case at rear of fuel
R spray nozzle at positions 2, 4, 6, 8, 10, 12, 14 and 16.

NOTE: The fuel spray nozzles are numbered clockwise viewed from the rear, No.1 being to the right of top dead centre.

B Carefully insert endoprobe in access port.

R C. Engines without S.B.73-6794, refer to fig.602 (Sheet 1),
R inspect fuel spray nozzles for the following:

R (1) Deflector cone for cracking, distortion, erosion,
R oxidation, burning, carbon build-up or sooting.

R (2) Shroud ring for burning, erosion and carbon build-up or
R sooting.

R D. Engines with S.B.73-6794, refer to fig.602 (Sheet 2), inspect
R fuel spray nozzles for the following:

R (1) Inner and outer flares for cracking, distortion, erosion,
R oxidation, burning, carbon build-up or sooting.

R (2) Shroud for burning, erosion and carbon build-up or
R sooting.

E. Check each fuel spray nozzle for correct location in miniflare bore as follows:

(1) Fuel spray nozzles in-line with boroscope access ports, check that the fuel spray nozzle shroud ring is concentric with miniflare bore.

(2) Fuel spray nozzles not in-line with boroscope access ports, check from access ports either side that the fuel spray nozzle shroud ring is concentric with the miniflare bore.

NOTE: The fuel spray nozzle is correctly located when the shroud ring penetrates the miniflare bore by a minimum of 2/3.

R F. For acceptance standards, refer to Para.4.A.

R 3. Close-Up

A. On completion of inspection, dismantle inspection equipment (Ref.72-00-00).

B. WARNING: WHEN USING DEGREASING FLUID, ENSURE ADEQUATE VENTILATION AND AVOID SKIN CONTACT AND INHALING THE VAPOUR.
Refer to fig.601, cold liquid degrease mating faces of blanking plugs (2) and combustion outer case and allow to dry.

C. CAUTION: ENSURE BOROSCOPE BLANKING PLUGS ARE CORRECTLY FITTED AND SECURED AFTER BOROSCOPE INSPECTION. FAILURE TO DO SO CAN RESULT IN ENGINE DAMAGE.
R Refer to fig.601, install blanking plugs as follows:

(1) Brush apply a thin coat of dry film lubricant to mating faces of blanking plugs (2) and combustion section outer case.

(2) While lubricant is still wet, position blanking plugs in combustion section outer case and secure with bolts (1).

D. Fit combustion section L.H., R.H. and upper fairings (Ref.72-03-00).

E. Remove spacer and side pieces and/or protective work mats from cold stream duct.

F. Unlock and reactivate thrust reverser and associated systems (Ref. 78-30-00).

4. Acceptance Standards

R A. Installed fuel spray nozzles

R (1) Shroud ring, refer to fig.602 (Sheet 1 or 2)

R (a) Burning and/or heavy erosion - Reject the fuel
R spray nozzle.

R (b) Fuel spray nozzle location:

R (i) Fuel spray nozzles incorrectly located -
R Reject engine.

R (2) Deflector cone, (Engines without S.B.73-6794) refer to
R fig.602 (Sheet 1)

R (a) Carbon build-up or sooting on deflector cone end
R face is acceptable.

R (b) Oxidation and/or erosion not resulting in
R distortion of the edge of the cone is acceptable.

R (c) Curling of the edge of the cone extending through
R an arc less than 90 degrees around the
R circumference is acceptable subject to periodical
R re-inspection. If curling of the edge of the
R cone extends through an arc greater than 90
R degrees the fuel spray nozzle must be removed
R (Ref. 73-11-06, Removal/Installation).

R (d) Cracks and loss of material - Reject the fuel
R spray nozzle.

(3) Fuel spray nozzle swirl chamber assembly condition,
R (Engines with S.B.73-6794) refer to fig.602 (Sheet 2)

(a) Burning and/or erosion leading to material loss from outer flare lip up to 10% of circumference and/or material loss from inner flare up to 20% of circumference is acceptable provided:

(i) Inner and outer walls are inspected and any damage is within limits (Ref.72-00-00).

(ii) Rear inner and outer combustion liner is inspected and any damage is within limits (Ref.72-00-00).

(iii) H.P. nozzle guide vanes are inspected and any damage is within limits (Ref.72-00-00).

(iv) Re-inspection is carried out at intervals not exceeding 450 hours.

R (b) Burning and/or erosion in excess of para.(3)(a) up to 25% of circumference from outer flare and up to 50% of circumference from inner flare lip is acceptable provided:

R (i) Inspection is carried out in accordance with
R para.(3)(a)(i) to (iii).

(ii) Re-inspection is carried out at intervals not exceeding 130 hours.

R (c) Radial cracking of inner and/or outer flare lip up to 0.20in. in length is acceptable.

R (d) Radial cracking as defined at para.(3)(c), with associated burning and/or erosion is acceptable provided:

(i) Fuel spray nozzle swirl chamber assembly is
R inspected in accordance with para.(3)(a).

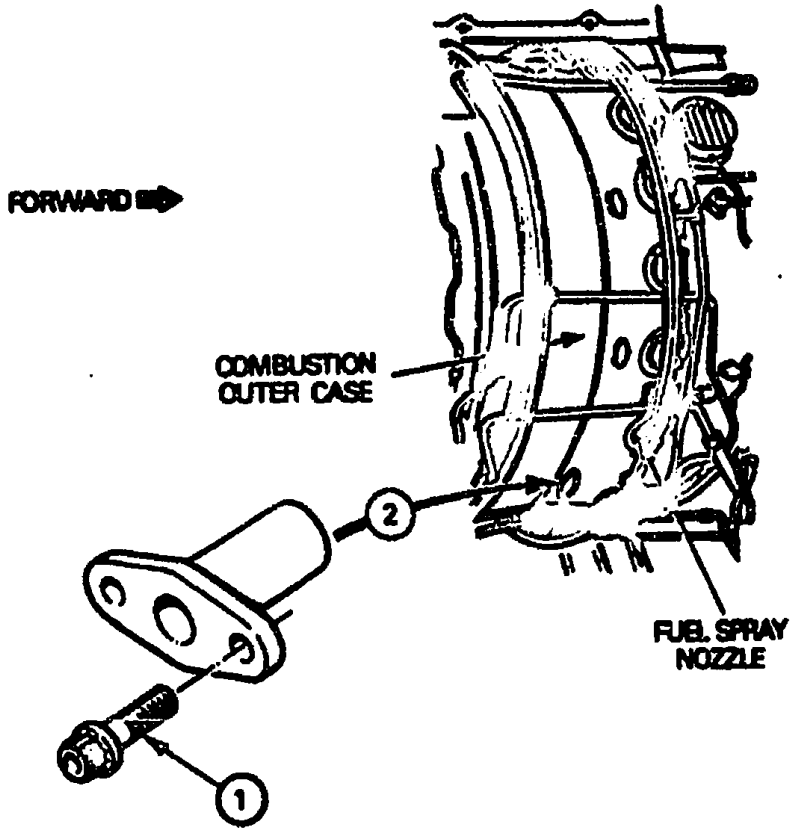
R (e) Any damage in excess of para.(3) - Reject fuel spray nozzle.

R (4) Carbon build-up

(a) CAUTION: IF EVIDENCE OF CARBON BUILD-UP IS PRESENT, INSPECT METERING PANEL FORWARD FACE FOR BURNING.

R Refer to fig.602 (Sheet 1 or 2), inspect gap between
R deflector cone or outer flare and swirl chamber lip
R for carbon build-up - If carbon build-up is present
R - Reject fuel spray nozzle.

R (b) Inspect metering panel forward face (Ref.72-00-00)
R if evidence of carbon build up is found. Gain
R access through fuel spray nozzle apertures. If
R evidence of burning is found - Reject engine.



1. Securing bolt (2 per plug)
2. Blanking plug (8 off)

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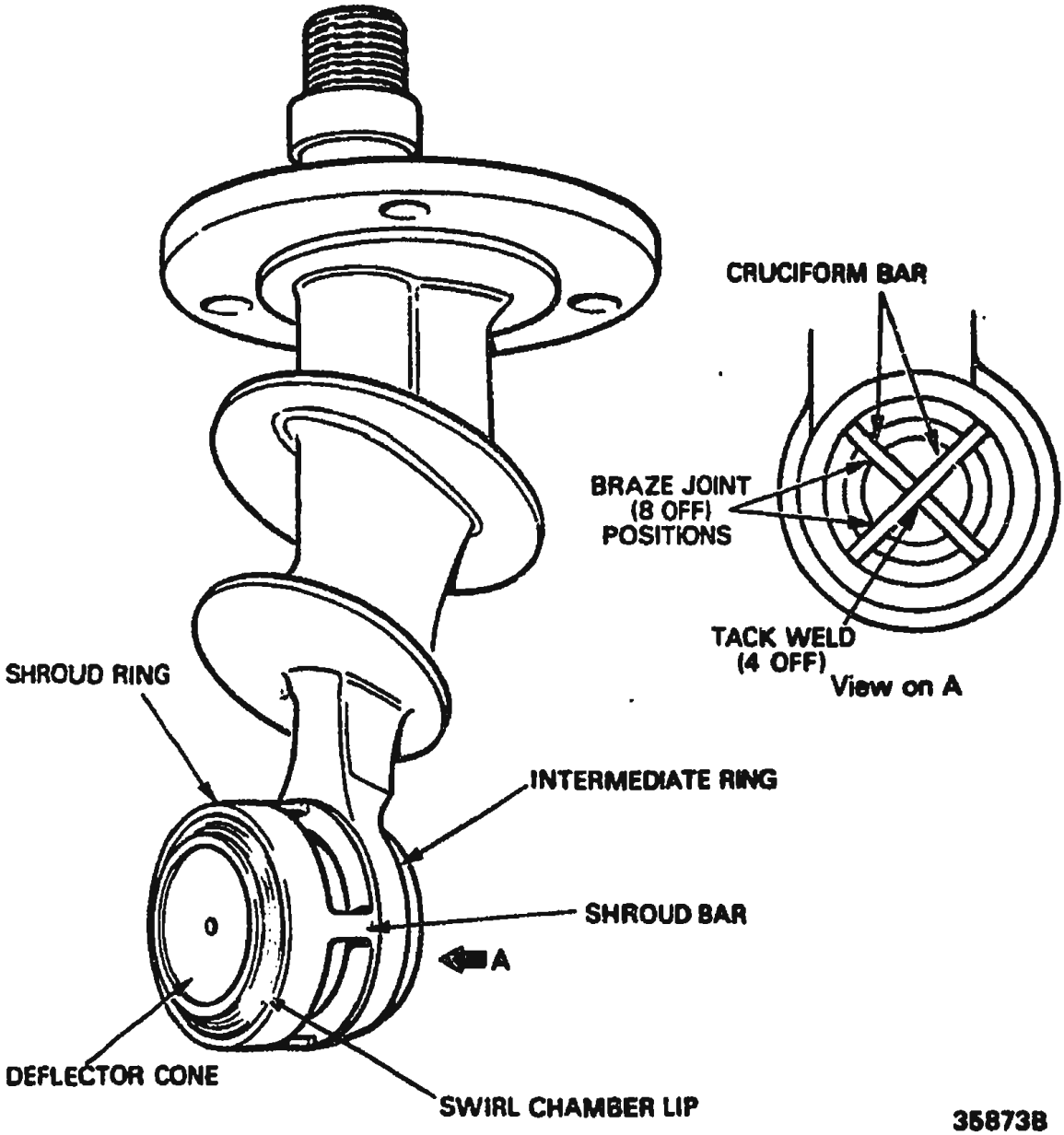
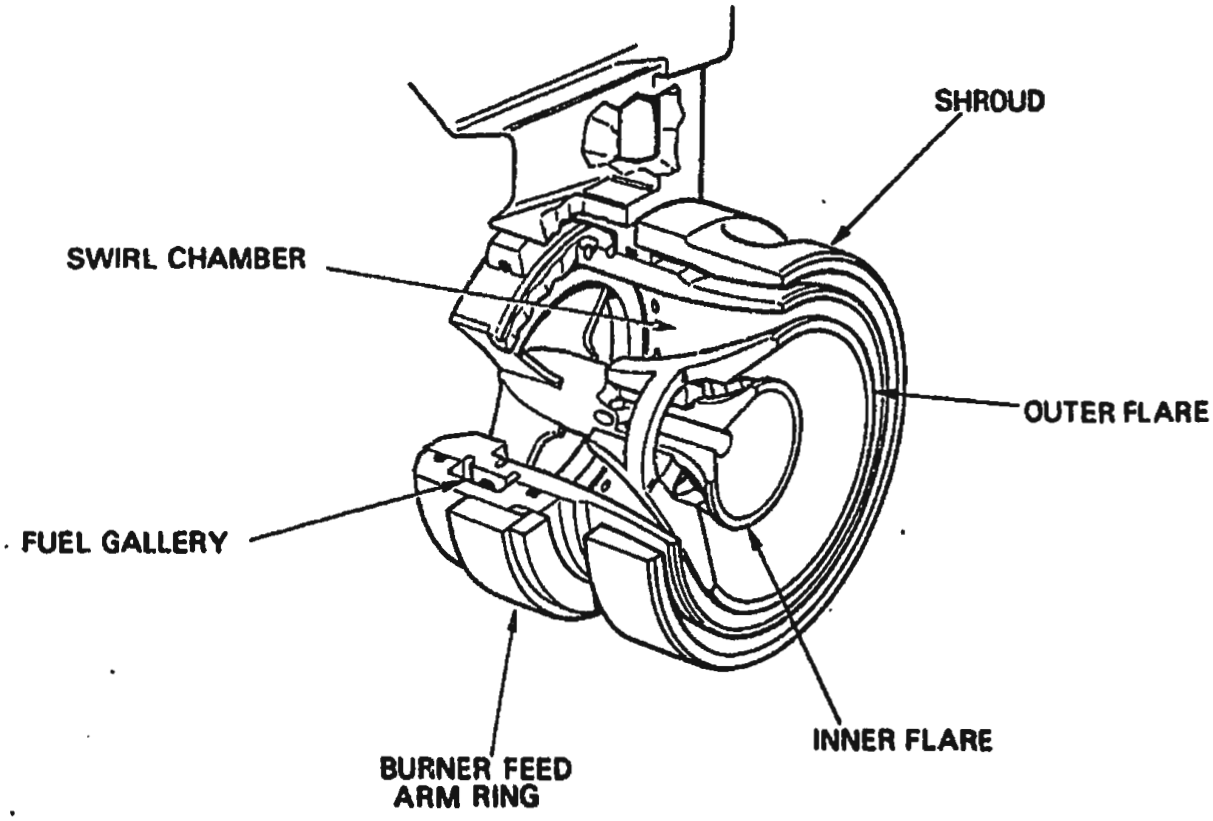
R Fuel spray nozzles boroscope access
R Fig.601



Fuel spray nozzles - Inspection/Check
(Engines without S.B.73-6794)
Fig.602 (Sheet 1)



Fuel spray nozzles - Inspection/Check
(Engines with S.B.73-6794)
Fig.602 (Sheet 2)

FUEL COOLED P4 AIR COOLER - REMOVAL/INSTALLATION

1. Removal/Installation Fuel Cooled P4 Air Cooler

Service Bulletins refered to:

S.B.73-2232 - Self consuming drains system
S.B.71-2388 - Re-routing of Engine L.T. harness
S.B.73-2534 - Revised fuel filter inlet
S.B.71-2577 - Additional clipping
S.B.73-3669 - L.P. Fuel Tubes with Reduced End Float
R S.B.73-5220 - L.P. Fuel Tube Connectors with Hard Coating
R Deleted

Referenced Procedures:

70-02-01	Indentification, Lubrication and Fitting of Rubber Sealing Rings
70-51-00	Torque Tightening Techniques
71-11-00	Cowling, Engines No.1 and No.3 - Servicing
71-12-01	L.H. and R.H. Lower Hinge Cowls - Servicing
71-12-05	L.H. and R.H. Upper Hinge Cowls - Servicing
73-00-00	Engine Fuel and Control - Servicing
73-00-00	Engine Fuel and Control - Adjustment/Test
73-11-09	Fuel Tubes - Maintenance Practices
78-30-00	Thrust Reverser - Servicing

Illustrated Parts Catalogue References:

The I.P.C. sections where parts disturbed during the following operations can be located are as follows:

73-11-09 Fuel System Tubes

A. Remove Fuel Cooled P4 Air Cooler

(1) Equipment required

Clean receptacle - minimum capacity

5 U.S. gallons
4 Imperial gallons
18 Litres

Flexible hose - approximate length 72in. (1800 mm.)
internal diameter 0.5in. (12 mm.)

CP.20309 or XUT.37594 Working platform
or (XUT.42526 Spacer
(XUT.42527 Side piece

(2) On pilots overhead control panel, zone 210, pull appropriate Fire Emergency Shut-off Control.

(3) On flight engineer/second officer's aft circuit breaker panel CB3, zone 215, open and tag appropriate FUEL FLOW circuit breaker.

(4) WARNING: ENSURE THRUST REVERSER SYSTEM IS LOCKED IN FORWARD THRUST POSITION WHILE WORKING IN COLD STREAM DUCT.

Deactivate and tag thrust reverser and associated systems, and fit thrust reverser mechanical locks (Ref.78-30-00).

(5) Open left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL and DL for engine No.2 (Ref. 71-12-01 and 05).

(6) Drain engine L.P. fuel system (Ref. 73-00-00, Servicing).

(7) CAUTION: ENSURE ELECTRICAL CONNECTOR IS FREE FROM LIQUID AND/OR SOLID CONTAMINATION BEFORE DISCONNECTING. FAILURE TO DO SO COULD RESULT IN A FIRE.
Refer to fig.401, disconnect electrical connector (1).

(8) Engines not incorporating S.B.73-2534

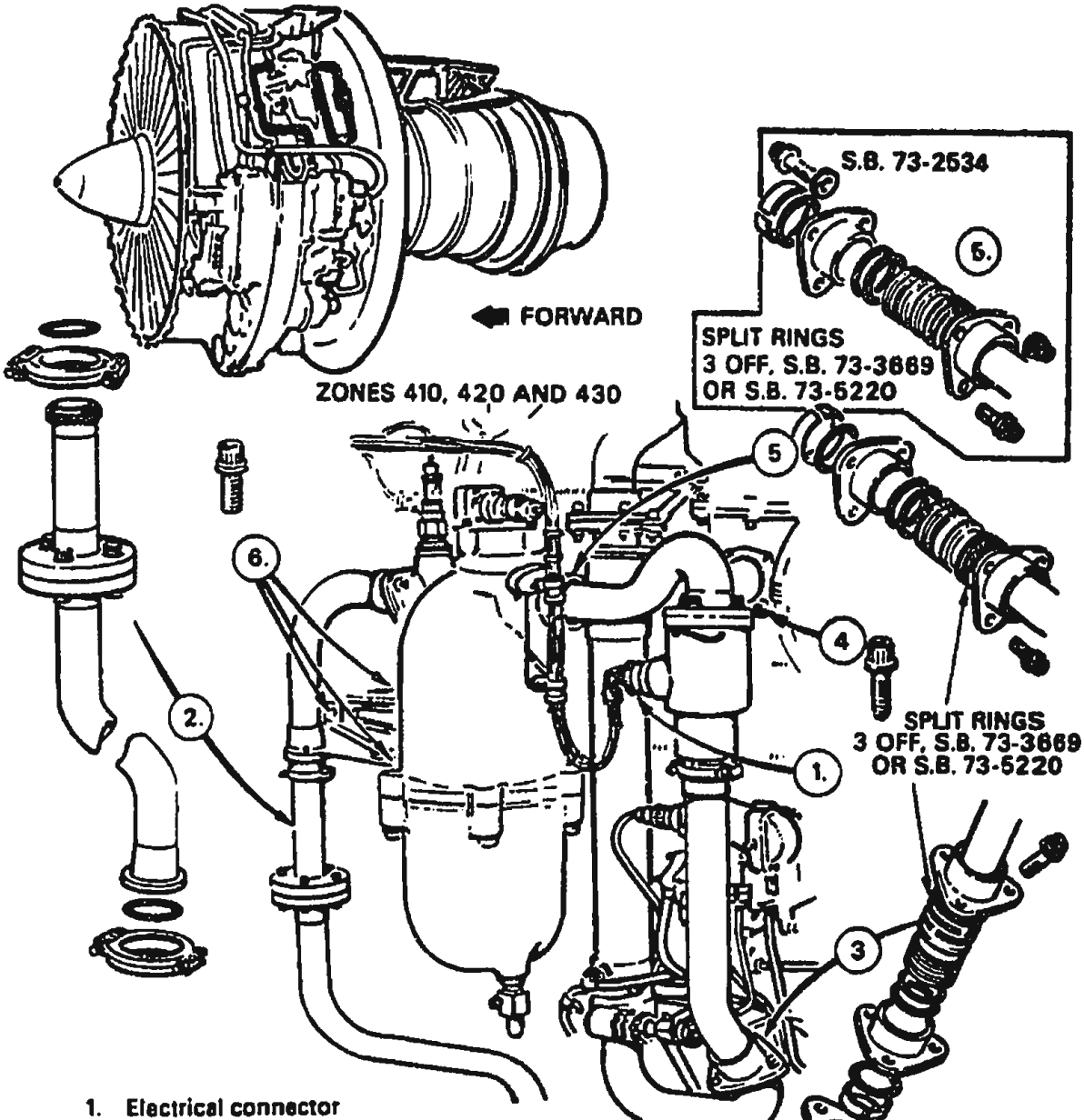
(a) Remove tube (2).

On engines incorporating S.B.71-2577, release clip from bracket at four bolt flange then remove tube (2).

(b) Disconnect connector (3). Leave bracket attached to tube support clips.

(c) Remove bracket securing bolts (4) from L.P. compressor case.

(d) Loosen connector (5).



1. Electrical connector
2. Tube—filter outlet tube connector to H.P. pump inlet
3. Connector—L.P. tube to P4 cooler
4. Securing bolt—flow transmitter support bracket (2 off)
5. Connector—L.P. tube to filter
6. Securing bolt—L.P. filter assembly (3 off)

R Fuel tubes and flow transmitter assembly disconnect points
R Fig.401

(e) Partially release securing bolts (6) and ease filter assembly away from L.P. compressor case.

(f) Disconnect connector (5) leaving harness support bracket connected to the harness. On engines incorporating S.B.71-2388, a bracket is not fitted at this position.

(g) Remove fuel tubes, flow transmitter and transmitter support bracket as an assembly.

(9) Engines incorporating S.B.73-2534

(a) Disconnect connector (3). Leave bracket attached to tube support clips.

(b) Remove bracket securing bolts (4) from L.P. compressor case.

(c) Disconnect connector (5) leaving harness support bracket connected to the harness. On engines incorporating S.B.71-2388, a bracket is not fitted at this position.

(d) Remove fuel tubes, flow transmitter and transmitter support bracket as an assembly.

(10) Fit working platform in cold stream duct.

(11) Refer to fig.402, enter cold stream duct and disconnect connector (1).

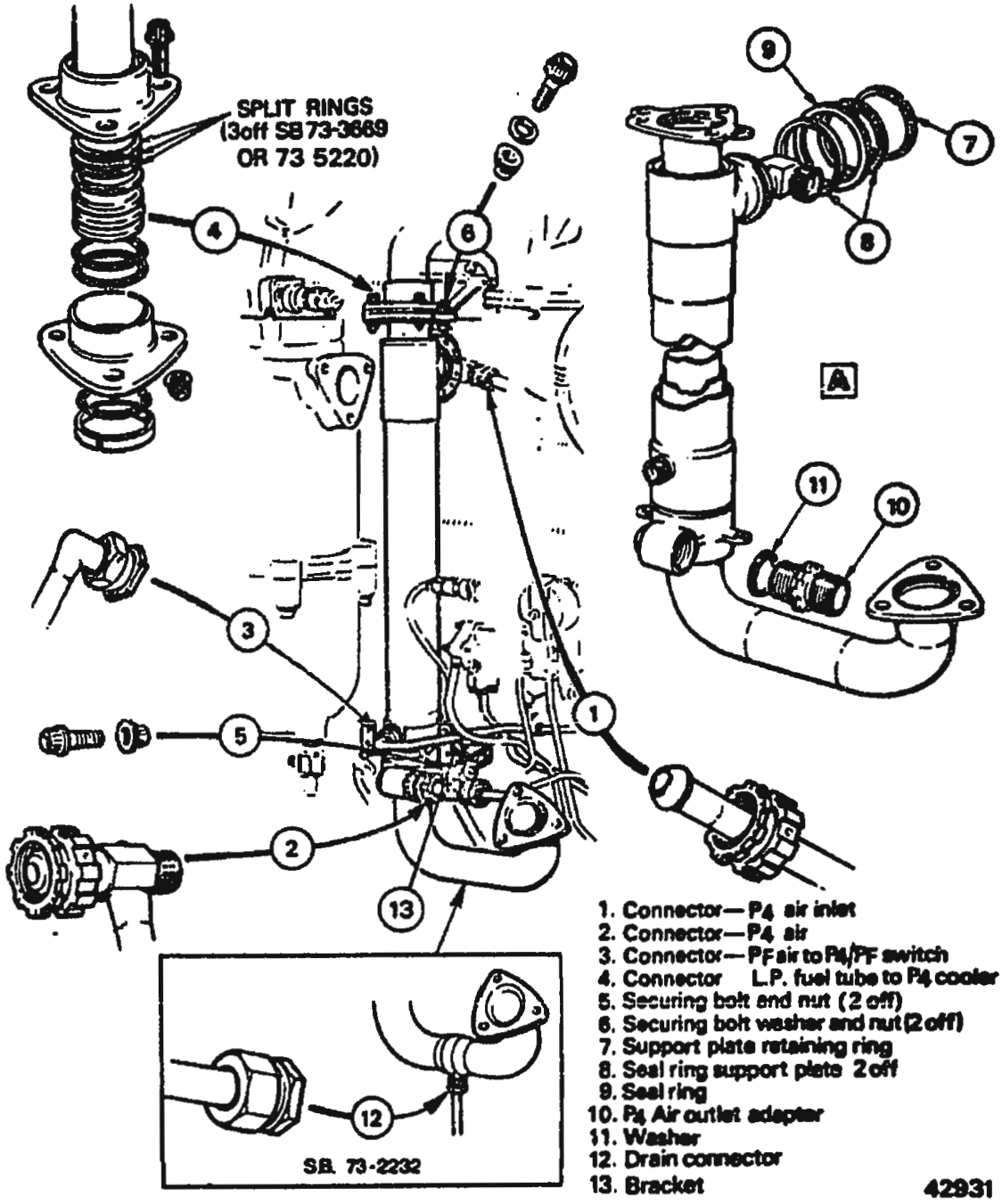
(12) Disconnect connectors (2), (3) and (4). On engines incorporating S.B. 71-2388 leave the harness support bracket connected to the harness at (4).

(13) On engines incorporating S.B. 73-2232, disconnect connector (12).

R (14) Remove bolts and nuts (5) and bracket (13).
R Retain bracket.

(15) Remove bolts, washers and nuts (6).

(16) Remove P4 cooler taking care not to damage the inside of seal housing when withdrawing P4 inlet connector (1).


SPLIT RINGS
(3off SB 73-3669
OR 73 5220)
SB. 73-2232
1. Connector—P4 air inlet
2. Connector—P4 air
3. Connector—PF air to P4/PF switch
4. Connector L.P. fuel tube to P4 cooler
5. Securing bolt and nut (2 off)
6. Securing bolt washer and nut (2 off)
7. Support plate retaining ring
8. Seal ring support plate 2 off
9. Seal ring
10. P4 Air outlet adapter
11. Washer
12. Drain connector
13. Bracket
42931

R
R

Fuel cooled P4 air cooler disconnect points
Fig.402

(17) Refer to A, fig.402, position cooler on work surface, remove retaining ring (7) then remove support plates (8) and seal ring (9). Retain these items for fitment to new cooler.

(18) Remove adapter (10) and washer (11). Retain adapter (10) for fitment to new cooler.

(19) Fit approved blanks to all exposed apertures and connectors.

B. Install Fuel Cooled P4 Air Cooler

R Refer to 73-11-09 for correct procedures for fitting fuel
R tubes.

(1) Equipment required:

CP.20309 or XUT.37594	Working platform
or (XUT.42526	Spacer
(XUT.42527	Side piece

(2) Material required:

	British Spec./Ref	American Spec./Ref	OMat Item No.
Lockwire	DTD.189A 22 S.W.G.	21 A.W.G.	238

(3) Ensure thrust reverser is locked and systems are deactivated and tagged as detailed in operations A.(2), (3) and (4).

(4) Ensure working platform is fitted in cold stream duct.

(5) Remove blanks, if fitted, from all apertures and connectors.

(6) Refer to A, fig.402, position new P4 cooler on work surface and fit seal support plates (8), seal ring (9) and retaining ring (7) to cooler in the order shown.

(7) Fit new washer (11) to adapter (10) then fit and secure adapter to cooler.

(8) Position cooler on support brackets on L.P. compressor case, taking care when inserting P4 air inlet connector (1) through seal housing not to damage inside of housing.

(9) Secure cooler with bolts, washers and nuts (6) and
R bolts and nuts (5), interposing bracket (13) between
R bolt head and support bracket.

(10) Fit and lubricate (Ref. 70-02-01) new seal rings to connector (4) then fit and secure connector. On engines incorporating S.B. 71-2388 interpose harness support bracket between bolt and connector.

(11) Connect and tighten (Ref. 70-51-00) connectors (3) and (2) and wirelock.

(12) On engines incorporating S.B. 73-2232, connect and tighten (Ref. 70-51-00) connector (12) and wirelock.

(13) Enter cold stream duct, connect and tighten (Ref. 70-51-00) connector (1) and wirelock. Remove working platform.

(14) Refer to fig.401, fit and lubricate (Ref. 70-02-01) new seal rings to all disturbed fuel connectors.

(15) Engines not incorporating S.B.73-2534

(a) Position fuel tube and flow transmitter assembly then connect and secure connector (5) interposing harness support bracket under heads of bolts. On engines incorporating S.B.71-2388 the harness is not connected at this point.

(b) Tighten L.P. filter assembly securing bolts (6).

(c) Fit tube (2) as detailed in 73-11-09.

On engines incorporating S.B.71-2577 secure harness clip to bracket at four bolt flange.

(16) Engines incorporating S.B.73-2534

(a) Position fuel tubes and flow transmitter assembly then connect and secure connector (5) noting bolts and 'D' washer adjacent to L.P. compressor case are fitted from the front. Interpose support bracket under heads of bolts fitted from the rear. On engines incorporating S.B.71-2388, a bracket is not fitted at this position.

(17) Connect and secure connector (3) interposing bracket between nuts and flange of cooler.

(18) Fit and secure bolts (4) through flow transmitter support bracket into L.P. compressor case.

(19) CAUTION: ENSURE ELECTRICAL CONNECTOR IS FREE FROM LIQUID AND/OR SOLID CONTAMINATION BEFORE CONNECTING. FAILURE TO DO SO COULD RESULT IN A FIRE.
Connect and secure electrical connector (1).

(20) Reactivate systems deactivated in operations A.(2) and (3).

(21) Unlock and reactivate thrust reverser and associated systems (Ref. 78-30-00).

(22) Prime L.P. fuel system (Ref. 73-00-00, Servicing) and test for leaks at points disturbed (Ref. 73-00-00, Adjustment/Test).

(23) Close left-hand hinged cowl, 413A or 423A for engine No.1 and 3 (Ref. 71-11-00) or 433AL and DL for engine No.2 (Ref. 71-12-01 and 05).

FUEL COOLED P4 AIR COOLER - ADJUSTMENT/TEST

1. Adjustment/Test Fuel Cooled P4 Air Cooler

Service Bulletin referred to:

S.B.74-2444 - Additional Clipping of Igniter Leads

Referenced Procedures:

70-51-00	Torque Tightening Techniques
71-11-00	Cowling, Engines No.1 and No.3 - Servicing
71-12-01	L.H. and R.H. Lower Hinged Cowls - Servicing
71-12-05	L.H. and R.H. Upper Hinged Cowls - Servicing
72-03-00	Gas Generator Fairings - Removal/Installation
78-30-00	Thrust Reverser - Servicing

Illustrated Parts Catalogue References:

The I.P.C. sections where parts disturbed during the following operations can be located are as follows:

73-21-04	Fuel System Air Tubes

A. Fuel Cooled P4 Air Cooler Pressure Test

(1) Equipment required:

CP.20309 or XUT.37594	Working platform
or (XUT.42526	Spacer
(XUT.42527	Side piece

CR Gen EPR tester 90087
CR Tool nbr. 73-11-03-0004

(2) Material required:

	British Spec./Ref.	American Spec./Ref.	OMat Item No.
Lockwire	DTD.189A 22 S.W.G.	- 21 A.W.G.	238

(3) WARNING: ENSURE THRUST REVERSER SYSTEM IS LOCKED IN FORWARD THRUST POSITION WHILE WORK IS IN PROGRESS.
Deactivate and tag thrust reverser and associated systems, and fit thrust reverser mechanical locks (Ref. 78-30-00).

(4) Open L.H. hinged cowl 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL (Ref. 71-12-01) and 433DL (Ref. 71-12-05) for engine No.2.

CR (5) Refer to fig.501, disconnect P4 air tube from fuel CR flow regulator, install pressure blank. (tool nbr. CR 73-11-03-0004) ref. tool and equipment manual.

CR (6) Remove P4 line at P4/PF switch and cap line.

(7) Position working platform in cold stream duct.

(8) Remove following gas generator fairings (Ref. 72-03-00).

(a) Engines No.1 and 3

Compressor Section Rear L.H. Fairing 412FL or 422FL
Combustion Section L.H. Fairing 412JL or 422JL

(b) Engine No.2

Compressor Section Rear L.H. Fairing 432FL
Combustion Section L.H. Fairing 432JL

(9) Refer to fig.502, remove bolts and washers (1) and (2) and leave support clips on tube and igniter lead.

On engines incorporating S.B.74-2444, when removing bolt and washer (1) also remove spacer from between support clips.

CR (10) Refer to fig.502, remove tubes (3) and (4) and on CR engines with S.B.73-5160, remove centrisep cleaner CR and pressure blank P4 air tube from fuel cooled P4 CR air cooler. On engines without S.B.73-5160, refer CR to fig.501, disconnect then pressure blank P4 tube at CR F.F.R. connector.

CR (11) Connect pressure line tool from E.P.R. tester 90087
CR to P4 air tube on compressor intermediate case.

CR (12) Pump up pressure in E.P.R. tester.

CR (13) Open isolation valve and pressurize system to 30 Hg. then close isolation valve.

(14) Check connectors in P4 air tubes to cooler for leaks and retighten if necessary.

NOTE: There are two tube connectors between test rig and cooler. One is situated adjacent to lower L.H. support strut attachment lug on compressor intermediate case and the other on inside of L.P. compressor case adjacent to top of air cooler.

(15) Open isolation valve and re-pressurize system to
CR 30 Hg. then close isolation valve.

CR (16) Check pressure does not fall more than 2 Hg. in one minute.

(17) Disconnect air supply from test rig flexible hose.

(18) Open isolation valve to release pressure in system.

(19) Disconnect pressure test rig from P4 air tube on compressor intermediate case.

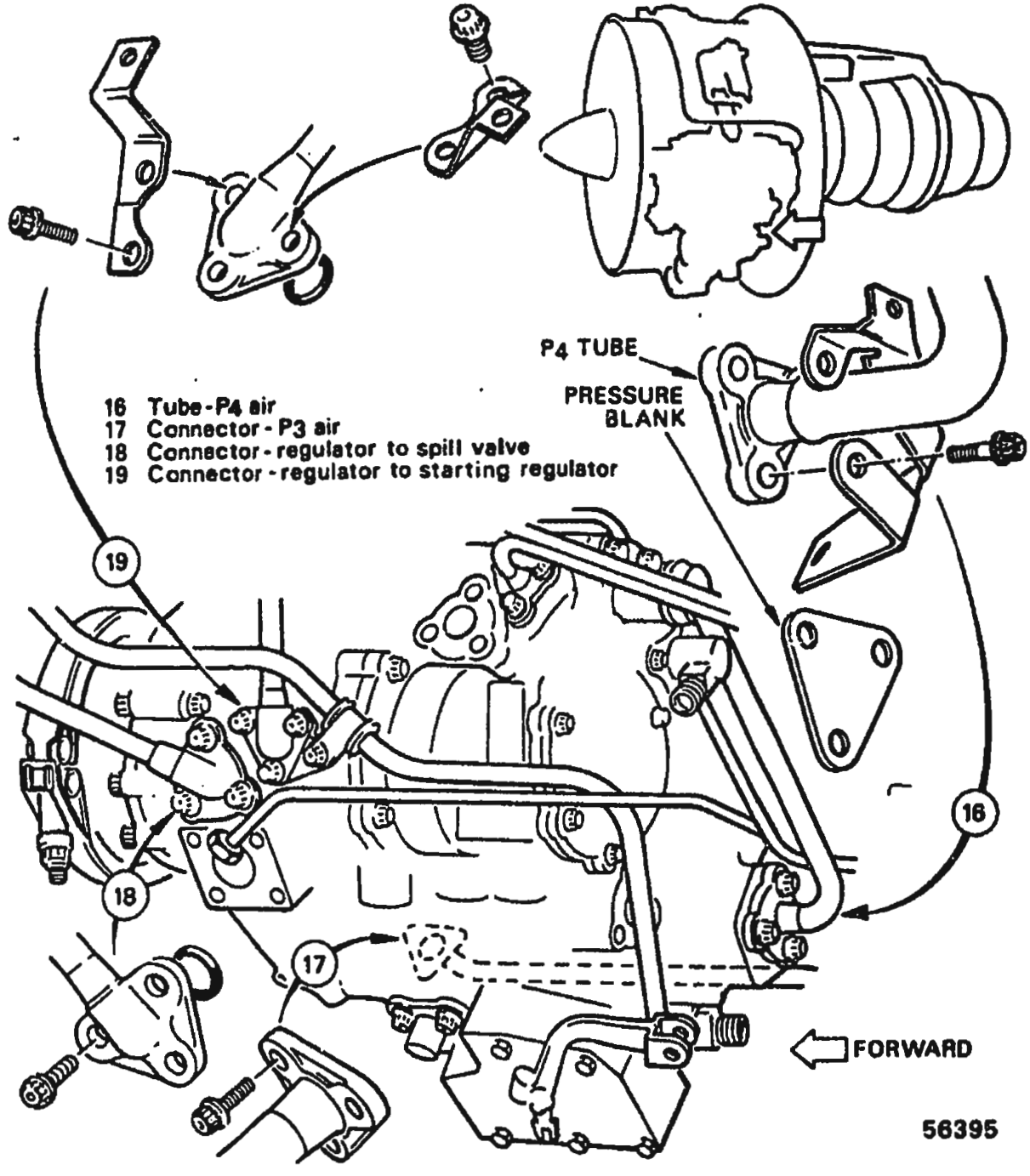
(20) Refer to fig.502, fit and secure (Ref. 70-51-00) air
CR tubes (4) and (3) then wirelock connectors, and/or
CR re-install cleaner.

(21) Secure tube and igniter lead support clips to brackets with bolts and washers (2) and (1).
CR Re-install as removed.

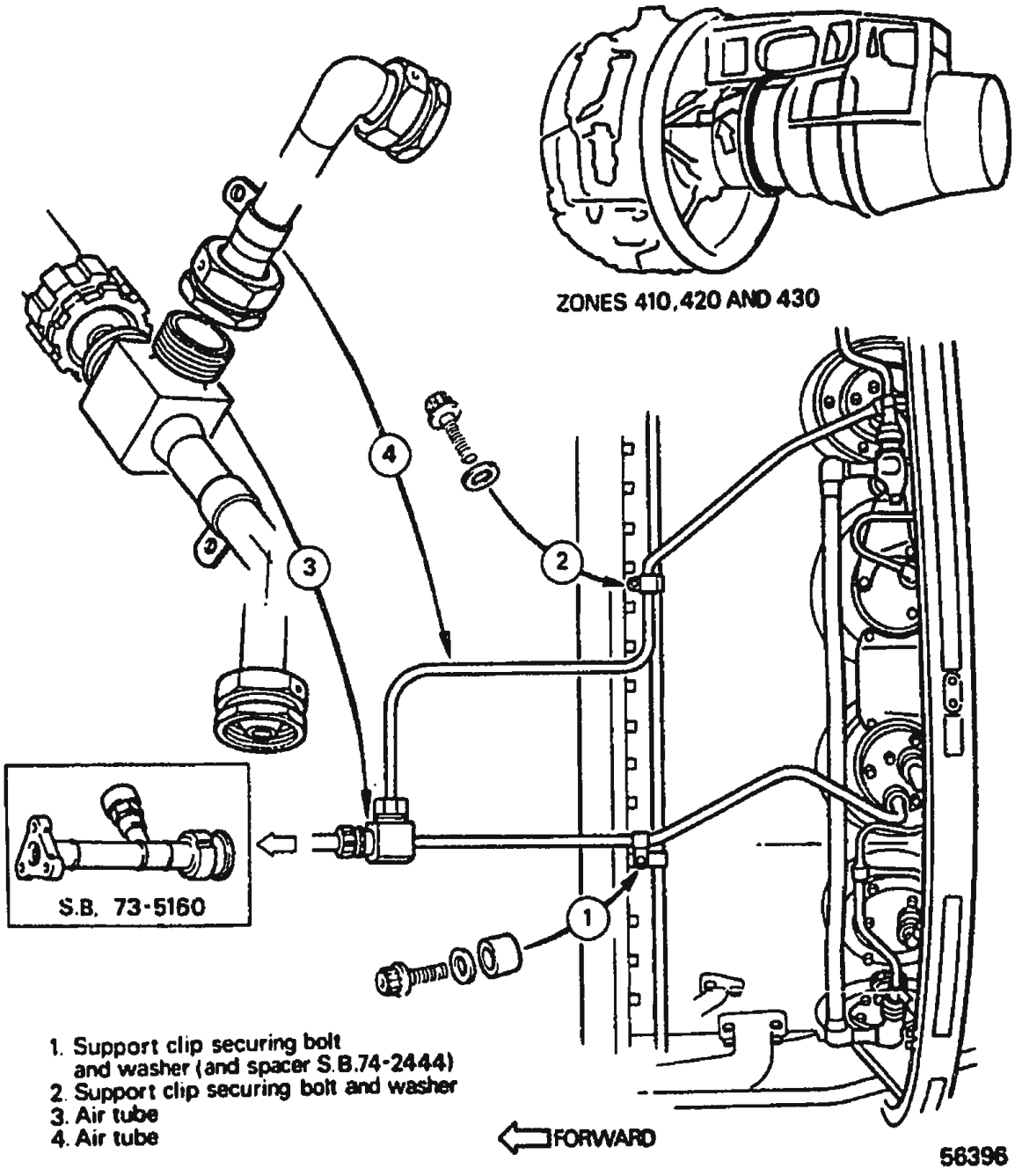
(22) Refer to fig.501, remove pressure blank then fit
CR and secure P4 air tube to fuel flow regulator.

CR (23) Re-connect P4 line at P4/PF switch and wirelock nut.

(24) Install gas generator fairings (Ref. 72-03-00) removed in operation (8).



CR Fuel Flow Regulator P4 air tube disconnect point
CR Fig.501



CR P4 air tubes disconnect points
CR Fig.502

(25) Remove work platform from cold stream duct.

(26) Close L.H. hinged cowl 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL (Ref. 71-12-01) and 433DL (Ref. 71-12-05) for engine No.2.

(27) Unlock and reactivate thrust reverser and associated systems (Ref. 78-30-00).

FUEL TUBES - REMOVAL/INSTALLATION

1. Removal/Installation Fuel Tubes - General

Referenced Procedures

70-02-01 Identification, Lubrication and Fitting of Rubber Sealing Rings
70-12-02 Fitting Vee Band Coupling Clamps

Illustrated Parts Catalogue References

The I.P.C. sections where parts disturbed during the following operations can be located are as follows:

73-11-09 Fuel System Tubes

A. Remove Fuel Tubes

CAUTION: WHEN WITHDRAWING TUBE FROM CONNECTORS, CARE MUST BE TAKEN TO AVOID DAMAGING TUBE.

(1) Remove tube support clips.

(2) Refer to detail A, fig.401 remove tubes with connector assembly. Either of the following two methods may be used as applicable.

R

(a) Remove bolts and washers (1) and withdraw tube from connector.

(b) Remove bolts and washers (2) and remove tube complete with connector. Remove bolts and washers (1) and separate connector from tube.

(3) Remove tubes with connector assembly.

(a) Refer to detail B, fig.401, remove washers, nuts and/or bolts (6) and remove tube.

(b) Slide retainer (7) along tube and remove connector (8).

(4) Remove tubes incorporating fixed end connectors (fig.203)

(a) Remove washers, nuts and/or bolts, or Vee-band coupling clamps (Ref. 70-12-02) as appropriate and remove tube.

(5) Discard all disturbed seal rings.

(6) Fit approved blanks to all exposed apertures and connectors.

B. Install Fuel Tubes

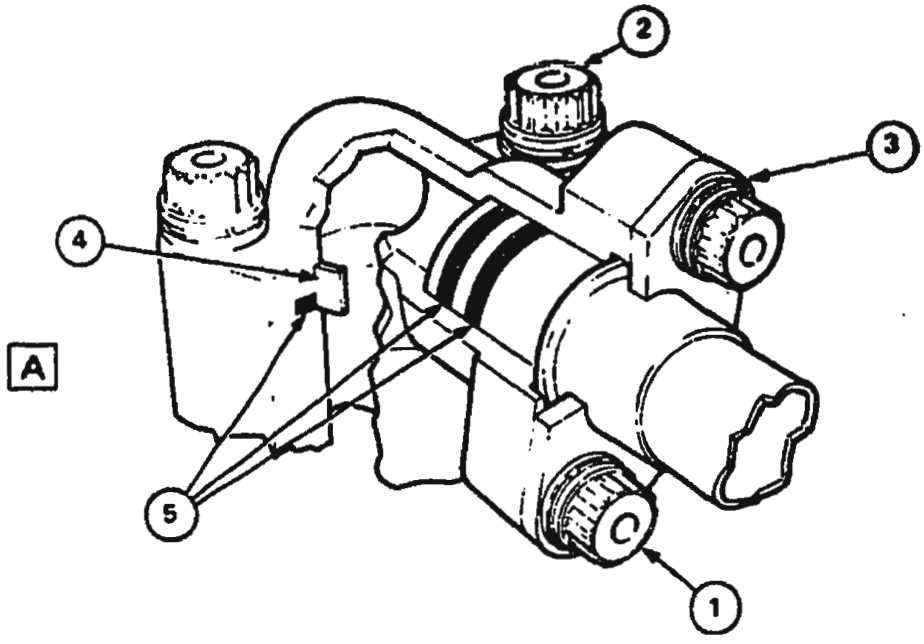
CAUTION: TUBES PUSH EASILY INTO CONNECTORS; RETAINING PLATES OR RETAINERS MUST NOT BE USED TO FORCE HOME TIGHT-FITTING TUBES, IF DIFFICULTY IS EXPERIENCED THE CAUSE MUST BE TRACED AND RECTIFIED.

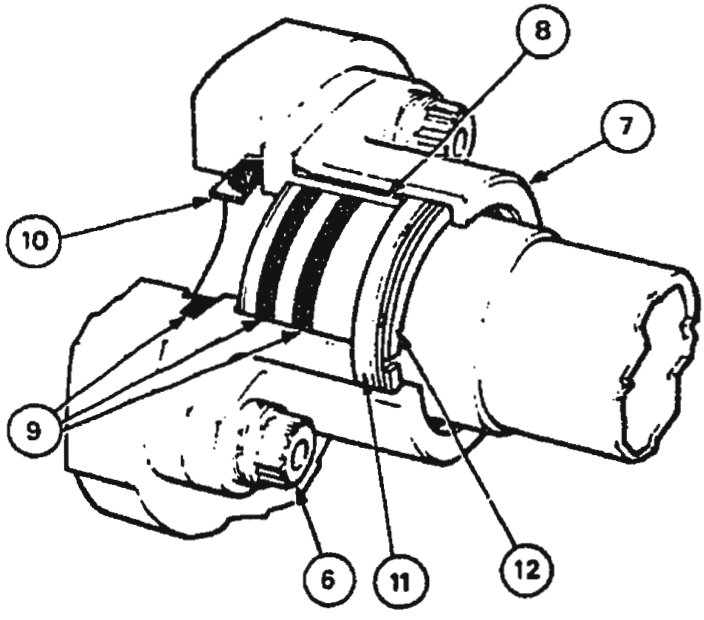
(1) Remove blanks, if fitted, from apertures and connectors.

(2) Ensure mating faces, connector bores and tube ends are clean and free from damage.

(3) Prepare Vee band clamps and Vee flanges for fitment (Ref. 70-12-02).

(4) Fit and lubricate (Ref. 70-02-01) new seal rings to relevant grooves on tube ends and/or connectors, and around seal retaining rings as appropriate.





1. Tube securing bolts and washer
2. Connector securing bolts and washers
3. Retaining plate
4. Seal ring retainer
5. Seal rings
6. Securing washers, nuts and/or bolts
7. Retainer
8. Connector
9. Seal rings
10. Seal ring retainer
11. Tube collar
12. Split rings (S.B. 73-3669)

B

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R Typical fuel tube connectors
R Fig.401

(5) Refer to detail A fig.401, fit tubes with connector assembly. Either of the following two methods may be
R used as applicable.

(a) Fit connector to tube end taking care not to damage seal rings. Move retaining plate (3) into abutment with connector face then secure with bolts and washers (1) interposing locking plates, brackets or clips as detailed in relevant unit installation procedure. Fit tube in position on engine and secure connectors to units with bolts and nuts (2) interposing locking plates, brackets or clips as detailed in relevant unit installation procedure.

(b) Fit tube to connector (already secured to unit) taking care not to damage seal rings. Move retaining plate (3) into abutment with connector face and secure with bolts and washers (1), interposing locking plates, brackets or clips as detailed in relevant unit installation procedure.

(6) Fit tubes with connector assembly.

R (a) Refer to detail B. fig.401, slide connector (8) over seal rings until it abuts tube collar (11).

(b) Slide retainer (7) over connector (8).

(c) CAUTION: ENSURE POSITIVE RETENTION OF CONNECTOR ASSEMBLY 'B' BY CHECKING POSITION OF RETAINER (7) PRIOR TO EFFECTING THE FOLLOWING OPERATION.
Fit tube in position on engine and secure with washers, nuts and/or bolts (6), interposing locking plates, brackets or clips as detailed in relevant unit installation procedure.

(7) Fit tubes incorporating fixed connectors

(a) Fit tube in position on engine and secure with washers, nuts and/or bolts, or secure with Vee band coupling clamp (Ref. 70-12-02) as appropriate.

(8) Fit tube support clips as applicable.

2. Removal/Installation Fuel Supply Tube

Referenced procedures

70-51-00 Torque Tightening Techniques
71-00-00 Power Plant - Adjustment/Test
72-03-00 Gas Generator Fairings - Removal/Installation
78-30-00 Thrust Reverser - Servicing

Illustrated Parts Catalogue References

The I.P.C. sections where parts disturbed during the following operations can be located are as follows:

73-11-09 Fuel System Tubes

A. Remove Fuel Supply Tube

(1) Equipment Required:

UT.630/1	Spanner wrench
UT.893	Spanner wrench
UT.894	Spanner wrench
CP.20309 or XUT.37594	Working platform
or (XUT.42526	Spacer
(XUT.42527	Side piece

Clean receptacle - minimum capacity:

1 U.S. gallon
1 Imperial gallon
4 Litres

(2) WARNING: ENSURE THRUST REVERSER SYSTEM IS LOCKED IN FORWARD THRUST POSITION WHILE WORK IS IN PROGRESS.
Deactivate and tag thrust reverser and associated systems, and fit thrust reverser mechanical locks (Ref. 78-30-00).

(3) Fit Working Platform in cold stream duct.

R (4) Remove compressor section and combustion section fairings (Ref. 72-03-00).

(5) Position clean receptacle to collect fuel spillage when connectors disconnected.

(6) Refer to fig.402, remove nut, spacer and bolt (1). Leave clips on tubes.

(7) Remove bolt (2). Leave clips on tubes.

R (8) Using tool UT.893 disconnect connector (3).

R (9) Using tool UT.894, disconnect connector (4).

(10) Remove tube (5).

(11) Fit approved blanks to all exposed connectors.

B. Install Fuel Supply Tube

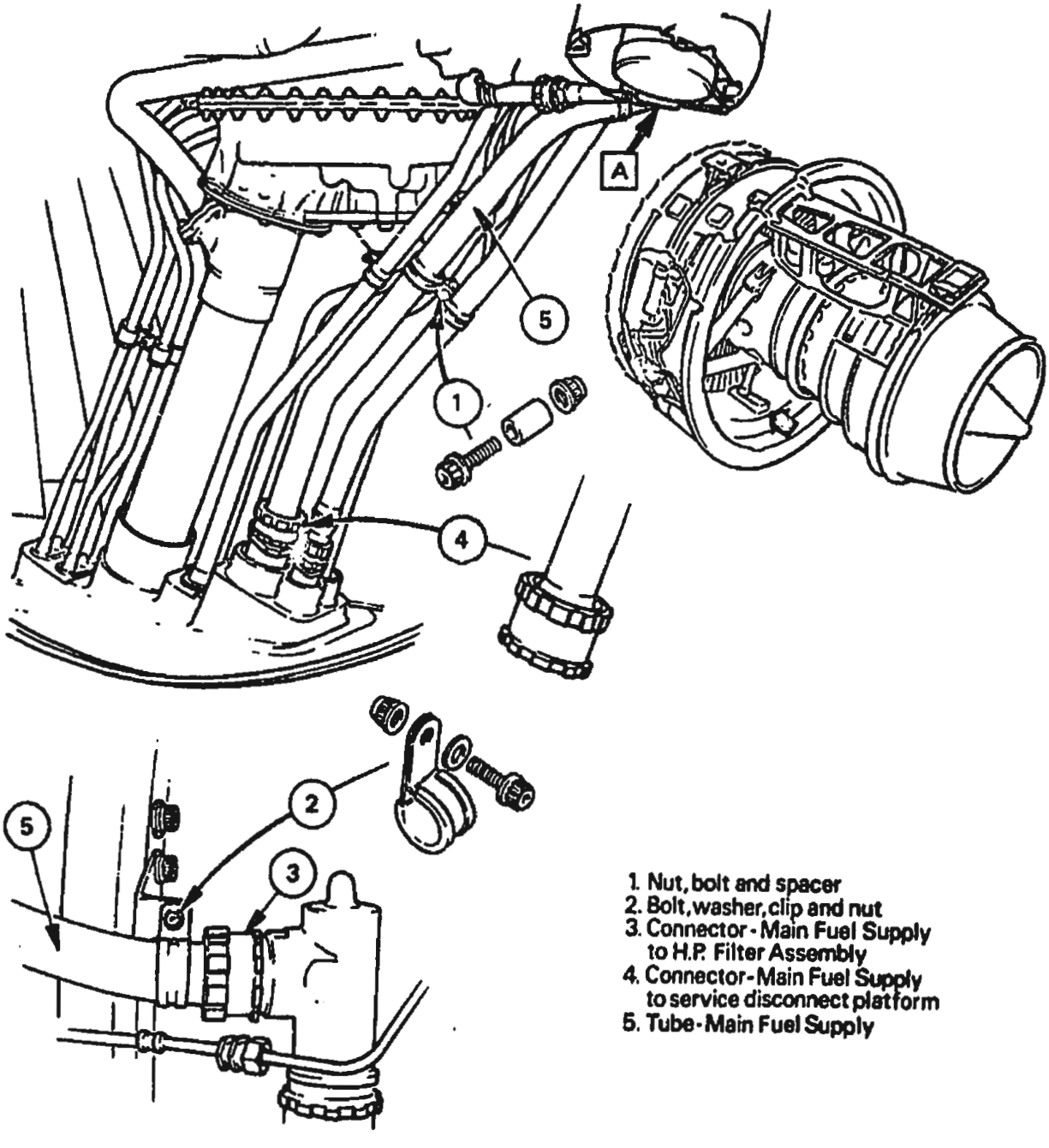
(1) Equipment required:

UT.630/1	Spanner wrench
UT.893	Spanner wrench
UT.894	Spanner wrench
CP.20309 or XUT.37594	Working Platform
or (XUT.42526	Spacer
(XUT.42527	Side piece

(2) Material required:

	British Spec./Ref.	American Spec./Ref.	OMat Item No.
Lockwire	DTD.189A 22 S.W.G.	 21 A.W.G.	238

(3) Ensure thrust reverser is locked and systems are deactivated and tagged as detailed in operation A.(2).



1. Nut, bolt and spacer
2. Bolt, washer, clip and nut
3. Connector - Main Fuel Supply to H.P. Filter Assembly
4. Connector - Main Fuel Supply to service disconnect platform
5. Tube - Main Fuel Supply

VIEW ON A

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R Fuel supply tube - disconnect points - Fig.402
R

(4) Ensure working platform is positioned in cold stream duct.

(5) Remove blanks from connectors.

(6) Refer to fig.402 if new tube is to be fitted, remove clips (1) and (2) from old tube and position on new tube (5).

(7) Position tube (5) at platform disconnect and main fuel manifold.

(8) Refer to fig.405, slacken connectors (1) (using tool UT.630/1) and (2) (using tool UT.894).

(9) Finger tighten connnectors (1) (2) (3) and (4) in sequence to align parts.

(10) Using spanner UT.630/1 torque tighten connectors (1) to 250 1b.in. (28.24 Nm.).

(11) Release connectors (1).

(12) Repeat operations (10) and (11) a further two times.

(13) Finally torque tighten connectors (1) to 500 1b.in. (56.48 Nm.) and wirelock.

R (14) Torque tighten connectors (2), (3) and (4) in sequence
R (Ref.70-51-00). Using tool UT.893, torque tighten
R connector (3) to 1020 lb.in. (115,2 Nm). Using tool
R UT.894, torque tighten connector (4) to the standard load
R and torque tighten connector (2) to 1440 lb.in.
R (162,7 Nm). Wirelock connectors (2), (3) and (4).

(15) Refer to fig.402 secure tube support clips with clips with bolt (2).

(16) Secure tube support clips with bolt, spacer and nut (1). Interpose spacer between tube support clips.

(17) Before next flight, test all disturbed connectors for leaks (Ref. 71-00-00, Table 501).

R (18) Fit compressor section and combustion section fairings (Ref. 72-03-00) and remove working platform.

R (19) Unlock and reactivate thrust reverser and associated systems (Ref. 78-30-00).

3. Install Fuel Tube - Filter Outlet Tube disconnect to H.P. Pump Inlet

Service Bulletins referred to:

S.B.71-2577 Engine light duty electrical harness - additional clipping
S.B.73-2583 L.P. filter to fuel pump tube support bracket with elongated holes

Referenced Procedures

70-02-01 Identification, Lubrication and Fitting of Rubber Sealing Rings
70-12-02 Fitting Vee Band Coupling Clamps

Illustrated Parts Catalogue References

The I.P.C. sections where parts disturbed during the following operations can be located are as follows:

73-11-09 Fuel System Tubes

A. Refer to fig.403, prepare coupling clamps (1) and mating flanges for fitment (Ref. 70-12-02).

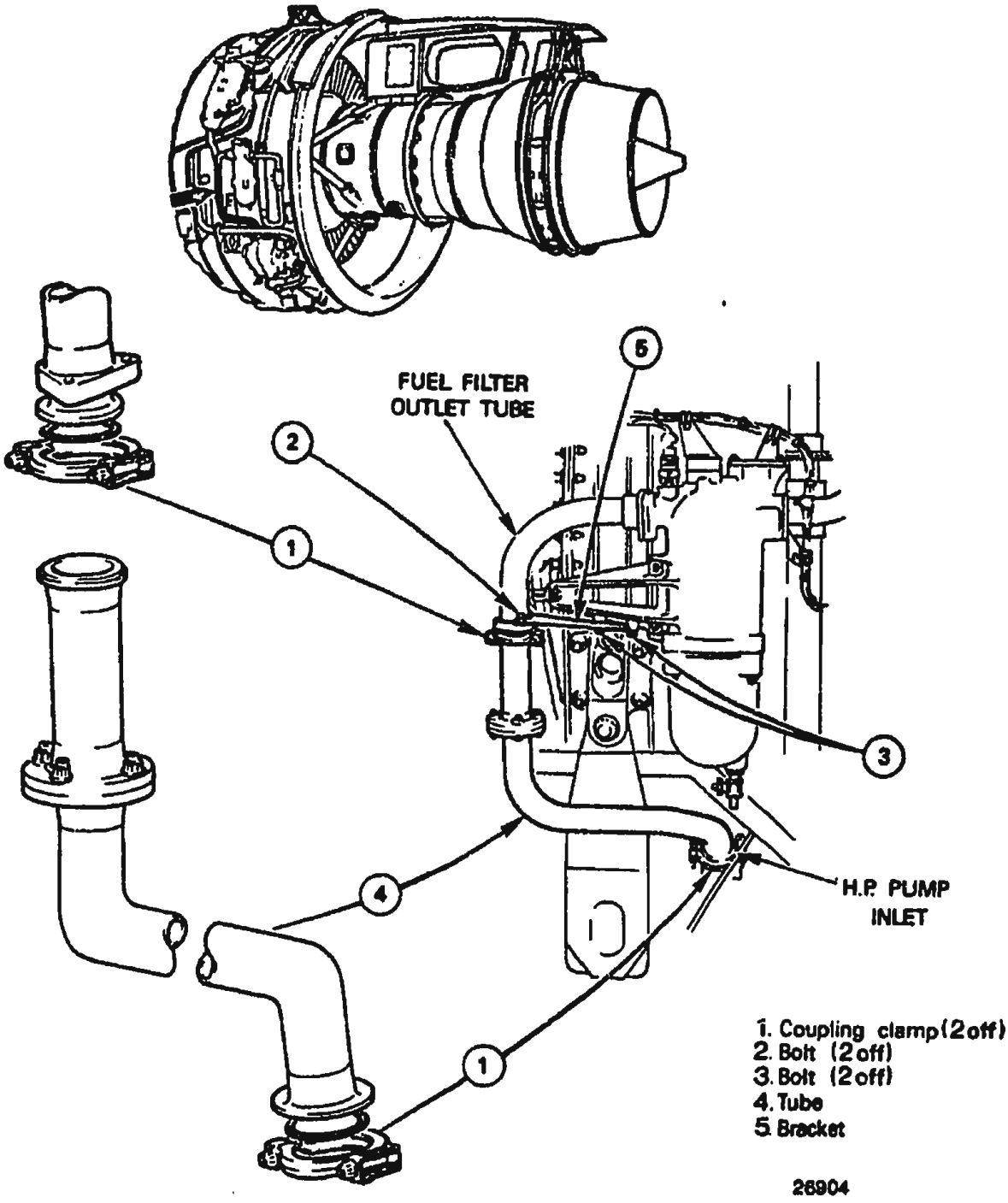
B. Fit and lubricate (Ref. 70-02-01) new seal ring to tube ends.

C. Fit L.P. fuel tube (engines not incorporating S.B.73-2583).

(1) Slacken bolts (2) and (3).

(2) Fit tube (4) between filter outlet tube and H.P. pump inlet; ensure holes in bracket (5) are
R aligned with threaded holes in filter housing web and filter outlet tube boss by checking bracket is free to move.

(3) Fit and secure (Ref. 70-12-02) coupling clamps (1) ensuring alignment achieved in operation
R (2) is maintained.



R Fuel tube installation
R Fig.403

R EFFECTIVITY: ALL

R (4) Secure bolts (2) and (3).

D. Fit L.P. fuel tube (engines incorporating S.B.73-2583)

(1) Slacken bolts and washers (2) and (3).

(2) Fit tube (4) and loosely fit coupling clamps (1).

(3) Secure (Ref. 70-12-02) coupling clamps (1) and tighten bolts and washers (2) and (3) carefully to avoid straining tube assembly.

E. On engines incorporating S.B.71-2577 - Secure harness support clip to bracket at four bolt flange.

4. Removal/Installation H.P. Fuel Filter

Referenced Procedures:

70-51-00	Torque Tightening Technique
71-00-00	Power Plant - Adjustment/Test
72-03-00	Gas Generator Fairings - Removal/Installation
78-30-00	Thrust Reverser - Servicing
78-31-20	Deflector Vanes (Cascades) - Maintenance Practices

Illustrated Parts Catalogue References:

R The I.P.C. sections where parts disturbed during the following operations can be located are as follows:

73-11-09 Engine Fuel System, Fuel Tubes.
78-31-20, Deflector Vanes (Cascades)

A. Remove H.P. Filter Element

An alternative method to this procedure is detailed in para.4.B.

(1) Equipment required:

CP.20309 or XUT.37594	Working Platform
or XUT.42526	Spacer
XUT.42527	Side piece
UT.893	Spanner wrench
UT.894	Spanner wrench

Clean receptacle - minimum capacity:

1 U.S. Gallon
1 Imperial Gallon
4 Litres

(2) WARNING: ENSURE THRUST REVERSER SYSTEM IS LOCKED IN FORWARD THRUST POSITION WHILE WORK IS IN PROGRESS.
Deactivate and tag thrust reverser and associated systems, and fit thrust reverser mechanical locks (Ref. 78-30-00).

(3) On pilots centre console, zone 210 ensure appropriate FUEL and IGNITION switch is in OFF position.

(4) Fit working platform in cold stream duct.

(5) Remove compressor section and combustion section fairings (Ref. 72-03-00).

(6) Position clean receptacle to collect fuel spillage when connectors are disconnected.

(7) Refer to fig.404, disconnect connectors (1) (using tool UT.893) and (2) (using tool UT.894).

(8) Remove filter body (3).

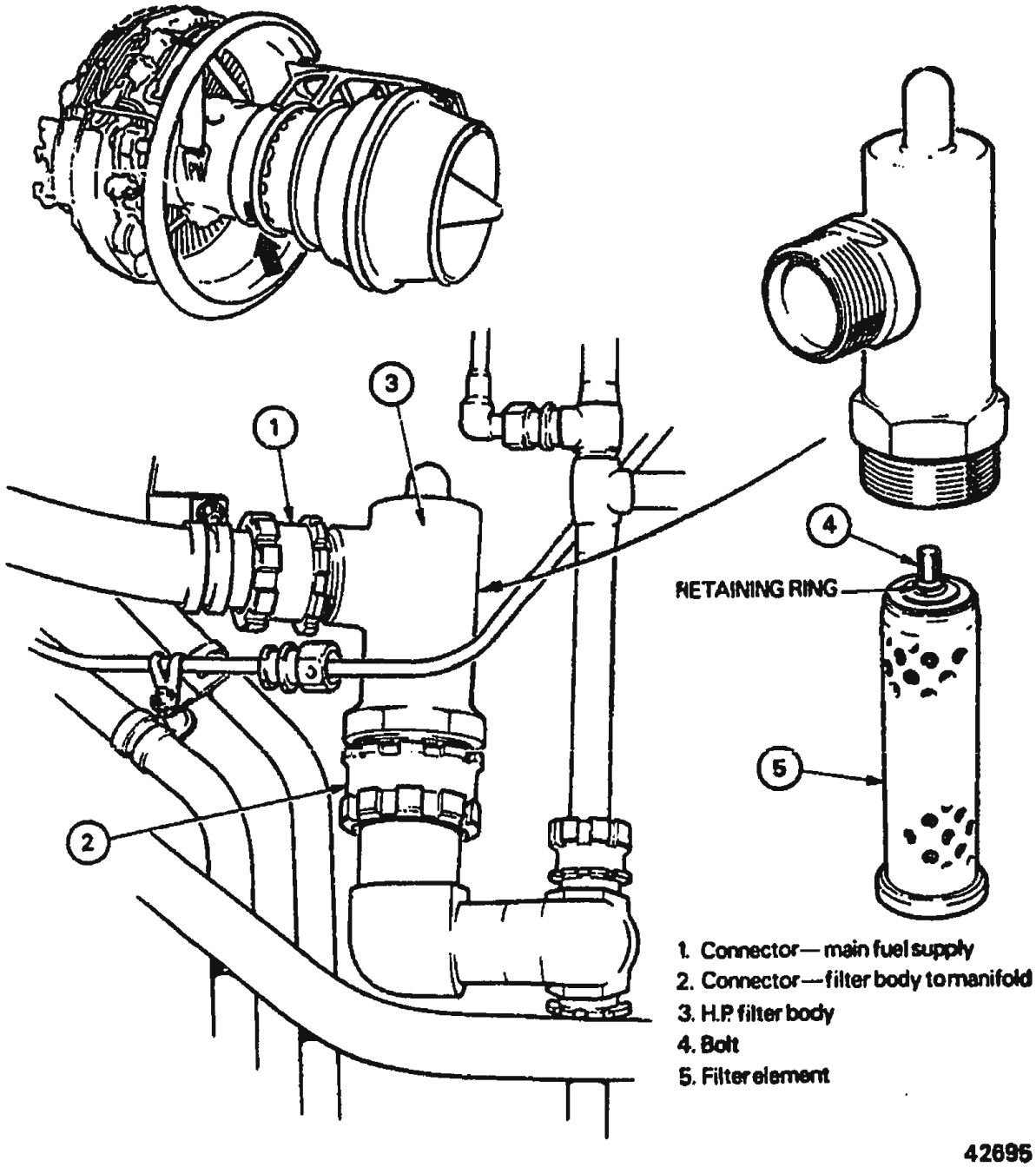
NOTE: Avoid scoring of tapered bore abutment faces.

(9) Fit approved blanks to all exposed connectors.

(10) Fully unscrew bolt (4).

(11) Withdraw filter element (5) together with bolt (4).

NOTE: Bolt (4) is retained in filter element (5) by a retaining ring.



1. Connector—main fuel supply
2. Connector—filter body to manifold
3. H.P. filter body
4. Bolt
5. Filter element

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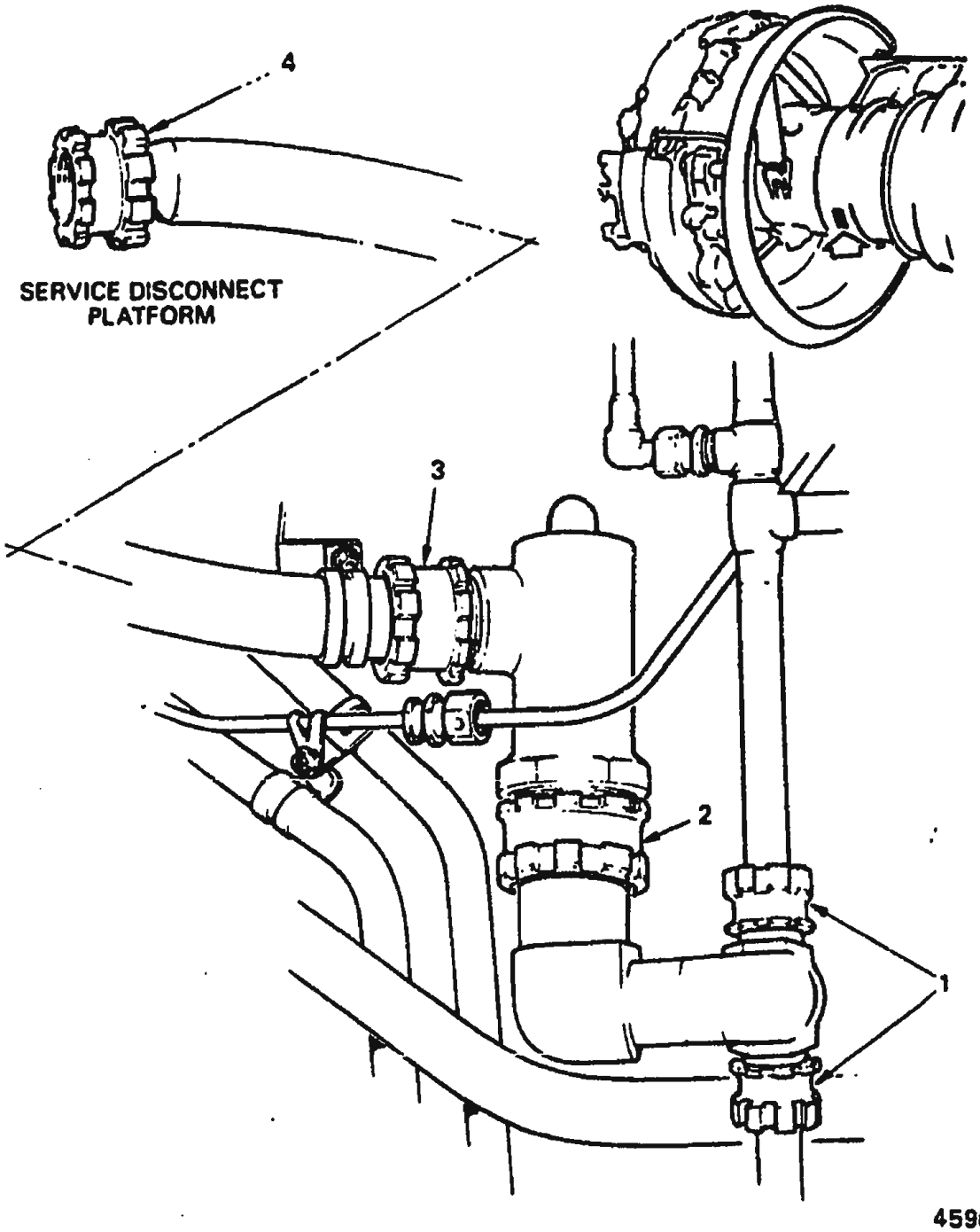
R H.P. Fuel Filter Removal/Installation -
R Fig.404

R EFFECTIVITY: ALL



R Torque tightening procedure for H.P. fuel
R tubes and fittings
R Fig.405

B. Remove H.P. Filter Element - Alternate Method

(1) Equipment required:

Clean receptacle - minimum capacity:

1 U.S. Gallon
1 Imperial Gallon
4 Litres

UT.893	Spanner wrench
UT.894	Spanner wrench

(2) WARNING: ENSURE THRUST REVERSER SYSTEM IS LOCKED IN REVERSE THRUST POSITION WHILE WORK IS IN PROGRESS.
Deactivate and tag thrust reverser and associated systems, and fit thrust reverser mechanical locks (Ref. 78-30-00).

(3) On pilots centre console, zone 210 ensure appropriate FUEL and IGNITION switch is in OFF position.

(4) Remove lower deflector vanes (cascades) Ref. 78-31-20.

(5) Remove compressor section and combustion section fairings (Ref. 72-03-00).

(6) Position clean receptacle to collect fuel spillage when connectors are disconnected.

(7) Refer to fig.404, disconnect connectors (1) (using tool UT.893) and (2) (using tool UT.894).

(8) Remove filter body (3).

NOTE: Avoid scoring of tapered bore abutment faces.

(9) Fit approved blanks to all exposed connectors.

(10) Fully unscrew bolt (4).

(11) Withdraw filter element (5) together with bolts (4).

NOTE: Bolt (4) is retained in filter element (5) by a retaining ring.

C. Install H.P. Filter Element

An alternative method to this procedure is detailed in para.4.D.

(1) Equipment required:

CP.20309 or XUT.37594	Working platform
or XUT.42526	Spacer
XUT.42527	Side piece
UT.630/1	Spanner wrench
UT.893	Spanner wrench
UT.894	Spanner wrench

(2) Material required:

	British Spec./Ref.	American Spec./Ref.	OMat Item No.
Lockwire	DTD.189A 22 S.W.G.	21 A.W.G.	238

R (3) CAUTION: IT IS ESSENTIAL THAT THE FILTER ELEMENT AND SECURING BOLT ARE CORRECTLY INSTALLED. DETACHMENT OF THE BOLT CAN RESTRICT FUEL FLOW AND RESULT IN SEVERE TURBINE DAMAGE.

R Refer to fig.404, check that retaining ring on securing bolt (4) to element (5) is undamaged, correctly positioned and secure.

R (4) Insert filter element (5) together with bolt (4) into filter body, check locking torque and fully tighten bolt (4) (Ref.70-51-00) to secure.

R (5) Ensure thrust reverser is locked and systems are deactivated and tagged as detailed in operation 4.A.(2) and (3).

R (6) Ensure working platform is positioned in cold stream duct.

R (7) Refer to fig.405, slacken connectors (1) (using tool UT.630/1) and (4) (using tool UT.894).

R (8) Remove blanks fitted to connectors (2) and (3).

(9) Position filter body between tube connectors (2) and (3).

NOTE: Avoid scoring of tapered bore abutment faces.

(10) Finger tighten connectors (1) to (4) in sequence to align parts.

(11) Using spanner, UT.630/1 torque tighten connectors (1) to 250 lb.in. (28.24 Nm.).

(12) Release connectors (1).

(13) Repeat operations (11) and (12) a further two times.

(14) Finally, torque tighten connectors (1) to 500 lb.in. (56.48 Nm.) and wirelock.

R (15) Torque tighten connectors (2), (3) and (4) in sequence
R (Ref. 70-51-00). Using tool UT.893, torque tighten
R connector (3) to 1020 lb.in. (115,2 Nm). Using tool
R UT.894, torque tighten connector (4) to the standard load
R and torque tighten connector (2) to 1440 lb.in.
R (162,7 Nm). Wirelock connectors (2), (3) and (4).

(16) Before next flight, test all disturbed connectors for leaks (Ref. 71-00-00, Adjustment/Test, Table 501).

(17) Fit gas generator fairings (Ref. 72-03-00) removed in operation 4.A.(5) and remove working platform.

(18) Unlock and reactivate thrust reverser and associated systems (Ref. 78-30-00).

D. Install H.P. Filter Element, Alternate Method

(1) Equipment required:

UT.630/1	Spanner wrench
UT.893	Spanner wrench
UT.894	Spanner wrench

(2) Material required:

	British Spec./Ref.	American Spec./Ref.	OMat Item No.
Lockwire	DTD.189A 22 S.W.G.	21 A.W.G.	238

R (3) CAUTION: IT IS ESSENTIAL THAT THE FILTER ELEMENT AND SECURING BOLT ARE CORRECTLY INSTALLED. DETACHMENT OF THE BOLT CAN RESTRICT FUEL FLOW AND RESULT IN SEVERE TURBINE DAMAGE.

R Refer to fig.404, check that retaining ring on securing bolt (4) to element (5) is undamaged, correctly positioned and secure.

R (4) Insert filter element (5) together with bolt (4) into filter body, check locking torque and fully tighten bolt (4) (Ref.70-51-00) to secure.

(5) Ensure thrust reverser is locked and systems are deactivated and tagged as detailed in operation 4.B.(2) and (3).

(6) Refer to fig.405, slacken connectors (1) (using tool UT.630/1) and (4) (using tool UT.894).

(7) Remove blanks fitted to connectors (2) and (3).

(8) Position filter body between tube connectors (2) and (3).

NOTE: Avoid scoring of tapered bore abutment faces.

(9) Finger tighten connectors (1) to (4) in sequence to align parts.

(10) Using tool UT.630/1, torque tighten connectors (1) to 250 lb.in. (28.24 Nm.).

(11) Release connectors (1).

(12) Repeat operations (10) and (11) a further two times.

(13) Finally, torque tighten connectors (1) to 500 lb.in. (56.48 Nm.) and wirelock.

R (14) Torque tighten connectors (2), (3) and (4) in sequence
R (Ref. 70-51-00). Using tool UT.893, torque tighten
R connector (3) to 1020 lb.in. (115,2 Nm). Using tool
R UT.894, torque tighten connector (4) to the standard
R load and torque tighten connectors (2) to 1440 lb.in.
R (162,7 Nm). Wirelock connectors (2), (3) and (4).

(15) Before next flight, test all disturbed connectors for leaks (Ref. 71-00-00, Adjustment/Test, Table 501).

(16) Fit gas generator fairings (Ref. 72-03-00) removed in operation 4.B.(5)

NOTE: Ensuring that the upper attachments are correctly located prior to tightening of fasteners.

(17) Replace Deflector Vanes (cascades) Ref. 78-31-02 removed in operation 4.B.(4).

(18) Unlock and reactivate thrust reverser and associated systems (Ref. 78-30-00).

R FUEL TUBES - INSPECTION/CHECK

R 1. Inspection/Check

R A. Inspection

R (1) Inspect fuel tubes for cracks, dents, scoring, nicks
R and frettage.

R B. Acceptance Standards L.P. Fuel Tubes

R (1) Cracks - No cracks acceptable

R (2) Dents - Smooth dents of a large area releative to
R depth, which do not reduce the diameter of
R the tube by more than 10 per cent at any
R one point, providing they are not within
R one diameter or 0.500in. (12,7 mm.),
R whichever is the greater, of the tube end
R fitting.

R Smooth dents of a small area up to 0.125
R sq.in. (8,065 sq.mm.) providing they are
R round bottomed and their depth does not
R exceed 0.015in. (0,381 mm.) on outside
R surface of a bend, 0.025in. (0,635 mm.)
R on remaining section of tube, and also
R providing they are not within one diameter
R or 0.500in. (12,7 mm.), whichever is the
R greater, of the tube end fitting.

R (3) Nicks - Nicks that are round bottomed providing
R they do not exceed 0.004in. (0,102 mm.) in
R depth and all burrs are removed.

R (4) Fretting - Fretting up to a maximum depth of 0.007in.
R (0,179 mm.) on outside surface of a bend;
R 0.010in. (0,254 mm.) on remaining sections
R of tube.

R (5) Scoring - Light scoring, providing it is not on the
R outside surface of a bend, can be blended
R out providing not more than 0.005in.
R (0,127 mm.) of metal is removed.

R C. Acceptance Standards H.P. Fuel Tubes

R (1) Cracks - No cracks acceptable

R (2) Dents - Smooth dents of a large area relative to depth, which do not reduce the diameter of the tube by more than 10 per cent at any one point, providing they are not within one diameter or 0.500in. (12,7 mm.) of the tube end fitting, whichever is the greater, and not on the outside surface of a bend.

Smooth dents of a small area up to 0.125 sq.in. (8,065 sq.mm.) providing they are round bottomed and their depth does not exceed 0.025in. (0,635 mm.) and they are not within one diameter or 0.500in. (12,7 mm.) of the tube end fitting, whichever is the greater, or on the outside surface of a bend.

R (3) Nicks - Nicks that are round bottomed and do not exceed 0.004in. (0,102 mm.) in depth providing all burrs are removed and they are not on the outside surface of a bend.

R (4) Fretting - Fretting up to a maximum depth of 0.004in. (0,102 mm.) providing it is not on the outside surface of a bend.

R (5) Scoring - Light scoring, providing it is not on the outside surface of a bend, can be blended out providing not more than 0.004in. (0,102 mm.) of metal is removed.

R FUEL TUBES - CLEANING, PAINTING AND PRESERVATION

R 1. Clean H.P. Fuel Filter Element

R Referenced Procedures:

R 73-11-09 - Fuel Tubes - Removal/Installation

R A. Equipment required:

R Compressed air supply

R B. Material required:

	British Spec./Ref.	American Spec./Ref.	OMat Item No.
Kerosine	Commercial Grade (D.Eng. RD2494)	-	101

R C. Remove H.P. filter element (Ref.73-11-09).

R D. Clean element (washing method)

R (1) Throughly wash element in clean kerosine; remove and shake off excess kerosine.

R (2) Using moisture free compressed air, apply blast to internal surface of element using sufficient pressure to remove any contamination without damaging element.

R (3) Place element against a background of light and visually inspect element for contamination.

R (a) If element is clean move to operation (5).

R (b) If element is still contaminated, repeat operation 1.D.(1) through (3).

R (4) If, after repeated washing, element is still contaminated, clean element in accordance with para.E.

R (5) Reassemble element and refit H.P. fuel filter (Ref.73-11-09).

R E. Clean element (ultrasonic method)

R (1) Immerse element in an ultra-sonic bath containing
R clean kerosine; operate bath for 10 minutes, then
R remove element and shake off excess kerosine.

R (2) Using moisture face compressed air, apply blast to
R internal surface of element, using sufficient pressure
R to remove any contamination without damaging element.

R (3) Place element against a background of light and visually
R inspect element for contamination.

R (a) If element is clean, reassemble element and refit
R H.P. filter (Ref.73-11-09).

R (b) If element is still contaminated repeat operation
R (1) through (3).

R **LOW PRESSURE (L.P.) FUEL INLET TUBE - MAINTENANCE PRACTICES**

1. Removal/Installation L.P. fuel inlet tube

Service Bulletin referred to:

R S.B.73-8105 - Fuel System - L.P. Inlet Tube - Addition of Flange
R Heat Shield and Tube Insulation

A. Remove L.P. fuel inlet tube

(1) Equipment required:

Clean receptacle - minimum capacity
5 U.S. gallons
4 Imperial gallons
18 Litres

(2) Ensure relevant ENG. TANK VALVE switch light is selected closed, Zone 215.

(3) Open left-hand hinged cowl, 413A or 423A for engines
R No.1 and No.3 (Ref. 71-11-00, Servicing) or 433AL for
R engine No.2 (Ref.71-12-01).

(4) Drain L.P. fuel supply tube (Ref. 73-00-00, Servicing).

R (5) On engines No.1 and 3 without S.B.73-8105 refer to
R Fig.201.

R (a) Remove nuts and bolts (1).

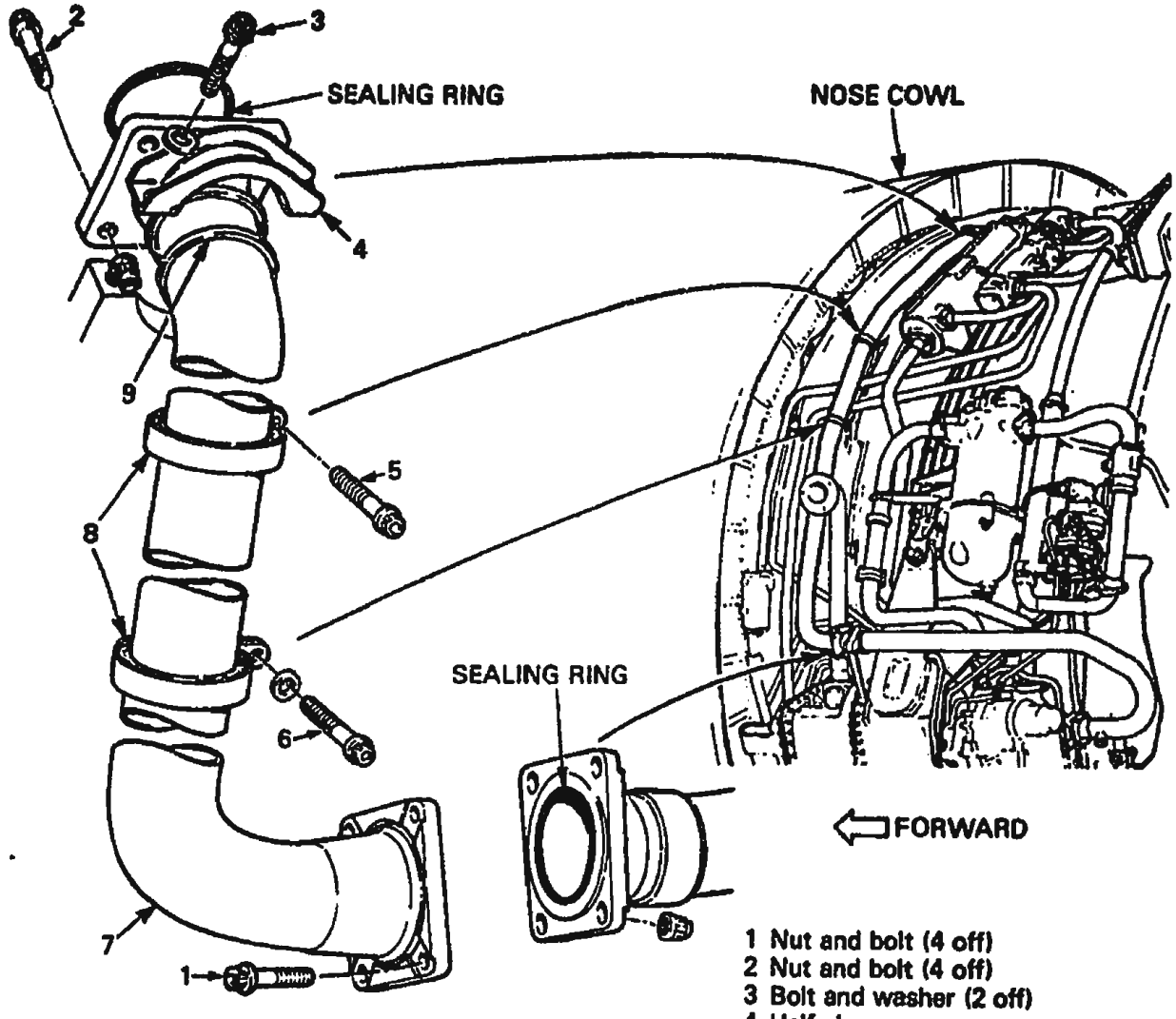
R (b) Remove nuts and bolts (2).

R (c) Remove bolts and washers (3), half-clamp (4).

R (d) Support fuel inlet tube (7) remove bolts (5) and
R bolts and washers (6); remove tube from engine.

R (e) If required remove clamps and cushions (8) and bush
R (9) for fitment to replacement fuel inlet tube.

R (f) To remove fuel tube aft of flange connection remove
R plate securing tube to support bracket and remove
R bolts (4 off) from tube connection at L.P. fuel
R pump.



1 Nut and bolt (4 off)
2 Nut and bolt (4 off)
3 Bolt and washer (2 off)
4 Half clamp
5 Securing bolt
6 Bolt and washer
7 LP inlet tube
8 Securing clamp and cushion (2 off)
9 Bush

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R Removal/Installation L.P. fuel inlet tube,
R engines No.1 and No.3
R Fig.201

(6) On engine No.2 without S.B.73-8105 disconnect flexible hose at flange connection by removing nuts and bolts (4 off). To remove fuel tube aft of flange connection remove plate securing tube to support bracket and remove bolts (4 off) from tube connection at L.P. fuel pump.

R (7) Engines No.1, No.2 and No.3 with S.B.73-8105 refer to Fig.202.

(a) Remove safety pin (4) slide nut cover (5) rearwards.

(b) Remove bolts and nuts (1, 2) and plate (3).

(c) Remove nuts and bolts (6, 7) from flange connection and disconnect flexible fuel hose on engine No.2.

(d) To remove fuel tube (12) forward of flange connection on engines No.1 and 3 carry out op (5)(b) to (e).

(e) Remove heatshield (8) and allow to be retained by retaining cord.

(f) Break locking wire between insulation tubes (10, 11) and tube support bracket.

(g) Remove bolts (4 off) from fuel tube connection at L.P. fuel pump and remove tube (13).

(8) Fit approved blanks to all exposed apertures.

B. Install L.P. fuel inlet tube

(1) If required, fit clamps and cushions (8) and bush (9), referred to in op.(5)(e), to fuel inlet tube (7).

(2) Remove blanks, if fitted, from apertures.

(3) Fit and lubricate new sealing rings (Ref. 70-02-01) to disturbed fuel tube connectors.

(4) On engines No.1 and 3 without S.B.73-8105 refer to Fig.201.

(a) Position fuel tube (7) to engine and loosely fit nuts and bolts (1).

(b) Loosely fit nuts and bolts (2).

(c) Fit and secure half-clamp (4) with bolts (3).

(d) Fit and secure bolts (5) and bolts and washers (6).

(e) Fit fuel tube aft of flange connection. Secure to support bracket with plate and connect to L.P. fuel pump.

(f) Torque tighten nuts and bolts (1, 2) and connection bolts at L.P. fuel pump 80 to 100 lbf.in.

(5) On engine No.2 without S.B.73-8105 connect flexible hose at flange connection. Fit fuel tube aft of flange connection. Secure to support bracket with plate and connect to L.P. fuel pump. Torque tighten flange connection bolts and connection bolts at L.P. fuel pump 80 to 100 lbf.in.

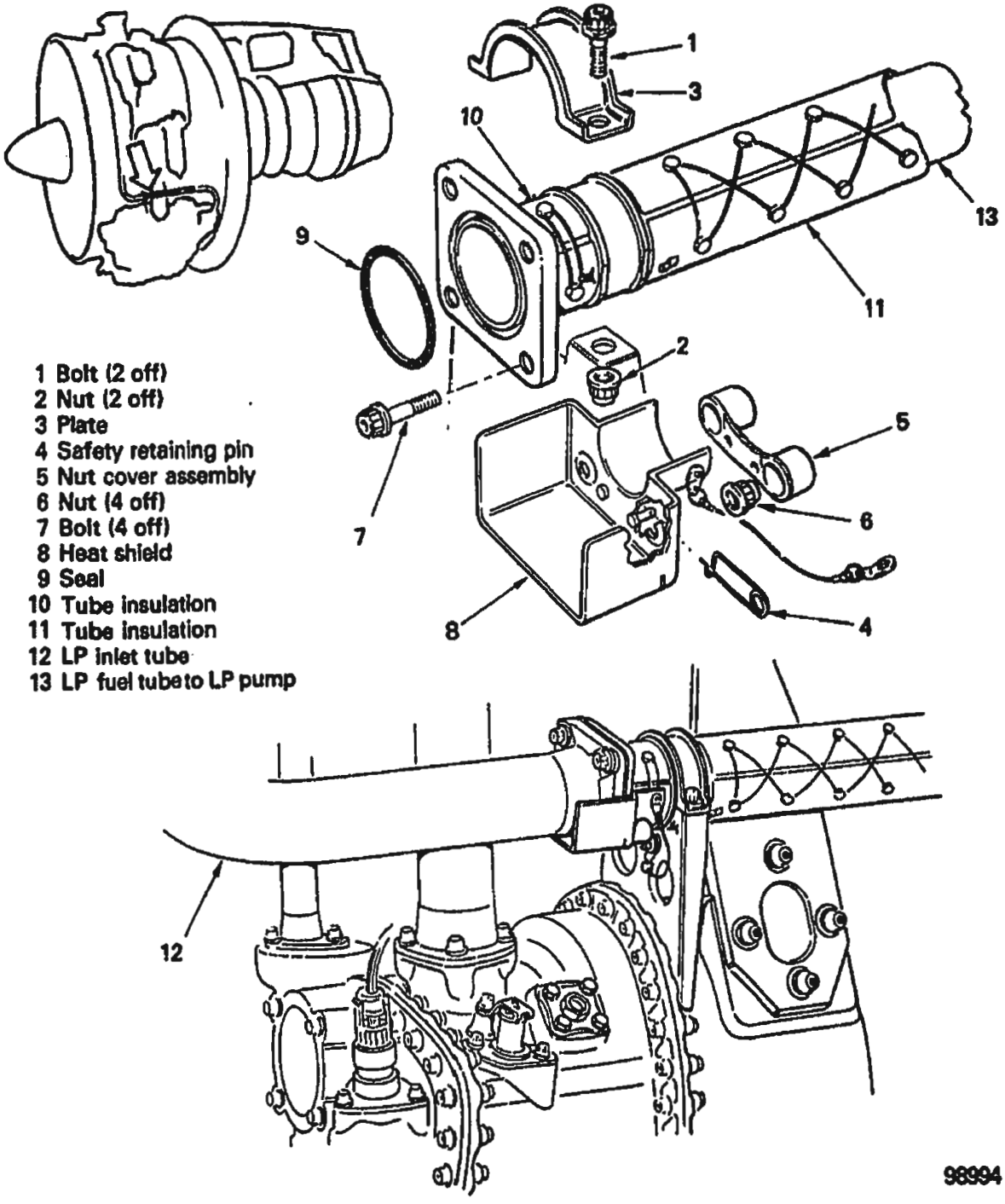
R (6) Engines No.1, No.2 and No.3 with S.B.73-8105 refer to Fig.202, fit fuel tube with insulation and heatshield assembly.

CAUTION: WHEN INSTALLING L.P. FUEL TUBE ENSURE MAXIMUM CLEARANCE IS ACHIEVED BETWEEN FUEL TUBE INSULATION AND H.S. GEARBOX SUSPENSION LINK. FAILURE TO DO SO WILL RESULT IN FRETTAGE OF THE LINK.

R (a) Fit and lubricate a new seal (9).

(b) Position fuel tube (13), insulation (11) and heatshield (8) and loosely fit nuts and bolts (6, 7) at flange connection.

(c) Loosely fit bolts (4 off) at L.P. fuel pump connection.



Removal/Installation L.P. fuel inlet tube,
Engines with S.B.73-8105
Fig.202

(d) Loosen bolts securing fuel tube support bracket to H.S. gearbox.

(e) Adjust fuel tube and support bracket away from gearbox suspension link and torque tighten bolts loosened at operation (6)(d) to standard loading.

(f) On engine No.2 connect flexible hose to flange connection and torque tighten nuts and bolts (6, 7) 80 to 100 lbf.in.

(g) On engines No.1 and 3 fit fuel tube (12). Carry out operations (4)(b) to (d).

(h) Torque tighten fuel inlet tube flange nuts and bolts at both ends of tube, and connecting bolts (4 off) at L.P. fuel pump 80 to 100 lbf.in.

(j) Fit plate (3) with bolts and nuts (1, 2).

(k) Install insulation (10) and wire lock insulation (10, 11) to support bracket.

(l) Prepare surface of heatshield (8) and nut cover assembly (5) to T.S.D.594, O.P.707.

(m) Position nut cover assembly (5) and bond to heatshield assembly (8) using SILCOSET 152 bond to T.S.D.594, O.P.707.

R (n) Fit the safety retaining pin (4) through the
R spigots which protrude through the nut cover
R assembly (5). Fasten the pin.

(p) Apply a bead of bonding agent and bond safety pin to cover.

(7) Prime L.P. fuel system (Ref.73-00-00, Servicing) and test for leaks at points disturbed (Ref.73-00-00, Adjustment/Test).

(8) Close and secure left-hand hinged cowl, 413A or 423A for engines No.1 and No.3 (Ref.71-11-00, Servicing) or 433AL for engine No.2 (Ref.71-12-01).

(d) Loosen bolts securing fuel tube support bracket to H.S. gearbox.

(e) Adjust fuel tube and support bracket away from gearbox suspension link and torque tighten bolts loosened at operation (6)(d) to standard loading.

(f) On engine No.2 connect flexible hose to flange connection and torque tighten nuts and bolts (6, 7) 80 to 100 lbf.in.

(g) On engines No.1 and 3 fit fuel tube (12). Carry out operations (4)(b) to (d).

(h) Torque tighten fuel inlet tube flange nuts and bolts at both ends of tube, and connecting bolts (4 off) at L.P. fuel pump 80 to 100 lbf.in.

(j) Fit plate (3) with bolts and nuts (1, 2).

(k) Install insulation (10) and wire lock insulation (10, 11) to support bracket.

(l) Prepare surface of heatshield (8) and nut cover assembly (5) to T.S.D.594, O.P.707.

(m) Position nut cover assembly (5) and bond to heatshield assembly (8) using SILCOSET 152 bond to T.S.D.594, O.P.707.

R (n) Fit the safety retaining pin (4) through the
R spigots which protrude through the nut cover
R assembly (5). Fasten the pin.

(p) Apply a bead of bonding agent and bond safety pin to cover.

(7) Prime L.P. fuel system (Ref.73-00-00, Servicing) and test for leaks at points disturbed (Ref.73-00-00, Adjustment/Test).

(8) Close and secure left-hand hinged cowl, 413A or 423A for engines No.1 and No.3 (Ref.71-11-00, Servicing) or 433AL for engine No.2 (Ref.71-12-01).

ENGINE FUEL CONTROL SYSTEM - DESCRIPTION AND OPERATION

1. General

The fuel control system enables fuel flow to be controlled from the flight station to effect engine starting, stopping and power selection. Starting and stopping are effected manually from a fuel and ignition switch that controls the operation of an electrically actuated high pressure shut-off valve. Power selection is effected manually from a throttle lever that connects, through a cable and linkage system, to an air throttle on the fuel flow regulator. The control system then automatically schedules fuel flow to support the power selected, provides power flat rating and ensures that specified engine parameters do not exceed predetermined limits.

Fig.3 illustrates the fuel control system diagrammatically,
R fig.2 the maximum speed or maximum speed and temperature limiting system diagrammatically and fig.1 a diagrammatic layout of the fuel regulator.
Service Bulletins referred to:
71-3641 - Introduction of S.T.A.103 amplifier
73-4592 - Introduction of increased cold day enrichment fuel flow
71-4176 - Light duty harness modified to suit Cal V. F.F.R.
71-5474 - H.P. left-hand bleed valve switching function interchanged with min V.M.O. solenoid release
R STA103-73-5 - Circuit changes to make T7 redatum relay normally open
FFR101-73-5673 - Introduction of additional V.M.O. by-pass
R 73-7620 - Introduction of improved Lucas N2 speed limiter SCA200
R as an alternative to amplifier STA103

R In the following Lucas mods.STA103-73-5 (R.R. S.B.83-4027),
R FFR101-73-5673 (R.R. S.B.73-5407)

2. Description

The control system consists of the following units:

Fuel flow regulator, which comprises a fuel regulator (fuel side) and a pressure ratio control (air side)
R I.P. shaft speed (N2) and T.G.T. control signal amplifier
Starting fuel flow regulator
P1 probe
Fuel enrichment solenoid
P4/PF switch

In addition the combined L.P. and H.P. fuel pump assembly and the H.P. fuel shut-off valve, while being basically distribution units, affect fuel control so their operational function is included in this section. A description of these units is given in 73-11-00.

The location of the control system units and associated air and fuel tubes is illustrated in 73-11-00, fig.3.

The automatic control system uses the ratio of H.P. compressor delivery pressure to air intake pressure (P4/P1) as the main control parameter. These pressures are sensed by the fuel flow regulator pressure ratio control and used to determine the positioning of a variable metering orifice, in the fuel regulator, to schedule fuel flow consistent with the power requirement set by the flight station throttle lever. To prevent surge during acceleration and deceleration, changes in the rate of fuel flow are matched to H.P. compressor conditions by the fuel flow regulator sensing P3, P4 and N3.

The total pressure drop created across the fuel regulator is sensed by a spill valve, in the H.P. fuel delivery line, which spills H.P. fuel in excess of the fuel regulator requirement back to the H.P. pump inlet.

Movement of the flight station throttle lever moves the air throttle and disturbs the balance of the P4/P1 ratio sensed by the pressure ratio control which repositions the metering orifice to increase or decrease fuel delivery to the spray nozzles consistent with the new power requirement.

R In addition to P4, P1 and N3, the control system also senses signals of T.G.T., P0, P3 and N2 in order to provide the following main control functions:

Power control from the flight station in forward and reverse thrust
A flat rated engine power control.
Uniform and surge free engine acceleration and deceleration
Limiting values for N1 (pre S.B.71-3351 and 71-3641), T.G.T., P4, N3 and N2
Correct engine light-up fuel flow at all altitudes below 32,000 ft.
High and low idle power.

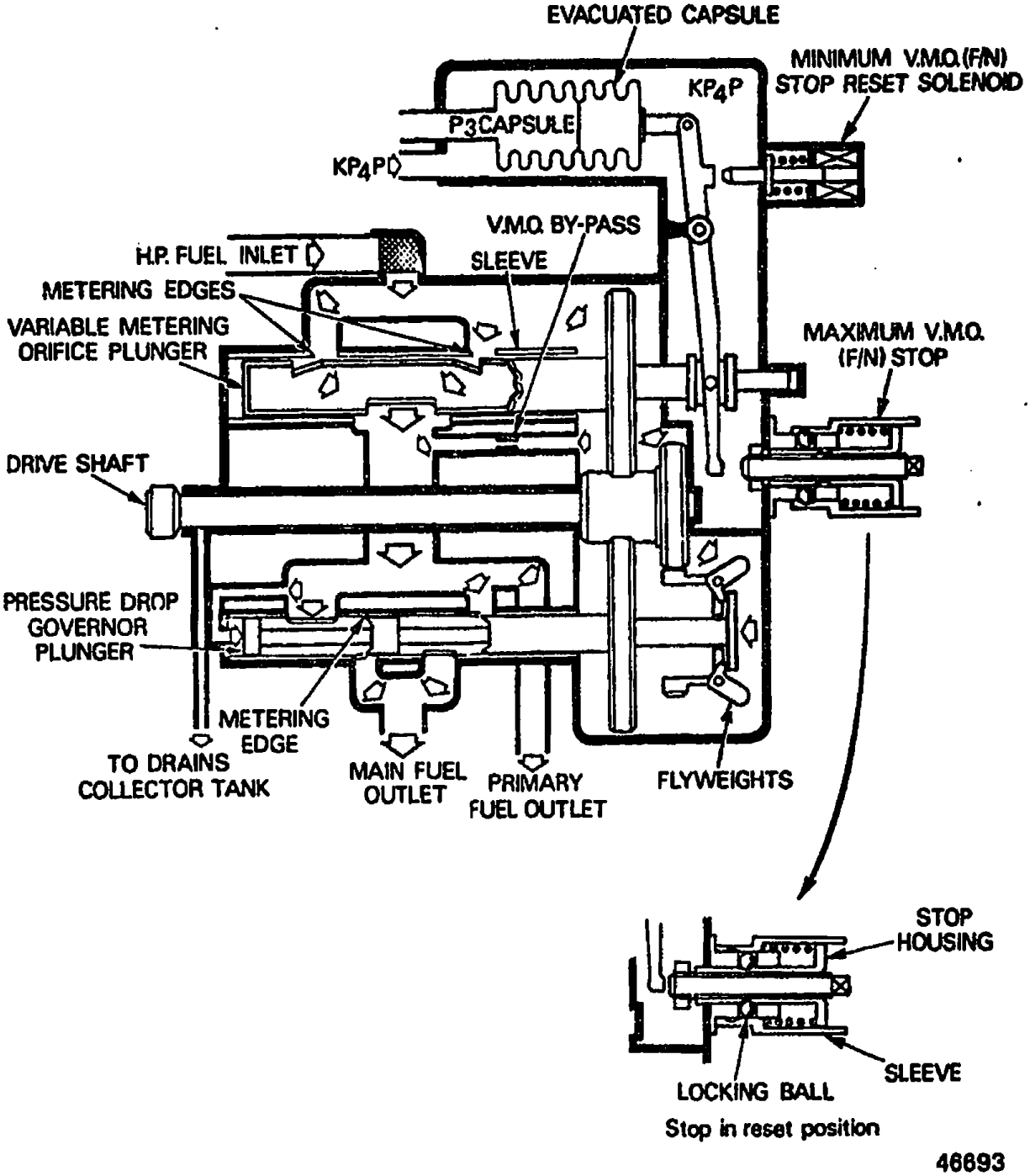
A. Normal Fuel Scheduling Description

From reference to fig.3 it will be apparent that the overall fuel pressure drop across the variable metering orifice and the pressure drop governor acts upon the pressure drop spill valve to position the valve and thereby control H.P. fuel spill to schedule fuel delivery consistent with the fuel regulator requirement. This requirement, due to the combined action of the metering orifice capsule stack air signal and the governor flyweight force, will be proportional to KP4P and N3.

The position of the trim valve, which is controlled by the pressure drop across the fixed and variable restrictors, also affects the pressure drop across the spill valve. Movement of the trim valve towards the closed position reduces fuel flow to the fuel flow regulator and increases the
R pressure differential sensed by the spill valve. The
R variable restrictor is controlled by an electric actuator altering the size of the variable restrictor orifice, to effect fuel trimming at maximum values of T.G.T. and/or specific engine shaft speed. The actuator is controlled by the control signal amplifier as described in B. Speed and Temperature Limiting System.

The KP4P pressure acting on the metering orifice capsule stack is a function of P4 being passed through a fixed air potentiometer which is also subject to P3. This results in a pressure P4P, between the restrictor and the venturi, which is then passed through a second restrictor and fed simultaneously to the metering orifice capsule chamber and the plate valve restrictor orifice.

The position of the plate valve restrictor, and therefore the value of KP4P, is determined by the movement of two bellows in the pressure ratio control.



R
R Fuel regulator diagrammatic layout
Fig.1

The control bellows pressure P4J is a function of P4 being passed through two restrictors, positioned in series, whose effective area is varied independently by the P1 sensitive adze trimmer assembly and the air throttle valve. P4J is also affected by the total flow area of a throttle by-pass comprising the idle orifice and the idle reset orifice. As the control bellows and its associated evacuated bellows are subject externally to P1, the position of the plate valve restrictor in the balance position (engine steady running) is a function of P4/P1, which is the engine overall compressor ratio and corresponds closely to thrust developed. Hence KP4P and therefore the flow area of the metering orifice in the steady running condition is a function of P4/P1.

Any variation in the P4/P1 ratio sensed by the pressure ratio control will result in the plate valve moving from the balance position to adjust the value of KP4P and therefore fuel flow, to re-establish the power selected. In this way the pressure ratio control provides engine power flat rating by scheduling fuel flow to support a constant thrust for a given altitude, aircraft speed and fixed power lever setting, irrespective of ambient temperature up to a specific I.S.A. limit. The continuation of power flat rating through ambient temperatures above the specific limit could result in turbine temperature or engine shaft speed limitations being exceeded. In consequence, in these conditions the engine must be restricted to limiting values of T.G.T or shaft speed and power is correspondingly reduced below the flat rated level.

Movement of the throttle lever alters the effective flow area of the air throttle multi-hole restrictor and therefore the value of P4J acting on the control bellows. This causes the plate valve restrictor to move onto the acceleration or deceleration stop, thus affecting KP4P and altering the fuel flow through the metering orifice accordingly. When the power selected is achieved, the pressures acting on the control bellows cause the bellows to move the plate valve restrictor to the balance position. KP4P, and therefore metering orifice area, then stabilizes and fuel flow is again scheduled to P4/P1.

The rate at which fuel flow through the metering orifice is increased during acceleration is scheduled against H.P. compressor conditions. This is effected by the pressure drop across the metering orifice being controlled proportional to N3 by the pressure drop governor and the flow area of the metering orifice being dependant on the H.P. compressor compression ratio P4/P3. Also, due to the action of the fixed air potentiometer, the increase in KP4P and therefore metering orifice flow area, is effected at a slower rate during low engine speeds than at high engine speeds.

The adze trimmer assembly modifies the normal flat rating function and minimizes the necessity for power lever adjustments during climb by progressively adjusting the P4/P1 ratio, set by the throttle lever, with P1, to achieve the climb power required. In ambient temperatures above the specific limit, climb power must be controlled by the throttle lever to ensure limiting values of T.G.T. or engine shaft speeds are not exceeded.

A reduced idle power (ground idle) is automatically selected on landing. This is effected by the air/ground sensing system (32-63-00) energizing the idle reset solenoid to close the valve and decrease the throttle by-pass area, thus increasing P4J. The reduced idle power is automatically cancelled when the throttle lever is opened beyond a predetermined position or reverse thrust is selected.

Stops incorporated in the fuel regulator limit the maximum and minimum fuel flow attainable through the metering orifice. The maximum stop limits engine pressures and stresses to an acceptable value, and the minimum stop ensures that, at altitude flight idle conditions, the engine offtake air available is sufficient for aircraft demands.

During engine starting the light-up fuel flow level is controlled by passing the primary fuel supply through an orifice in the starting fuel flow regulator, the flow area of which is set during calibration. Another orifice in the starting regulator allows a flow of H.P. delivery fuel supply to enrich the primary supply during starting. The enrichment supply is controlled by a solenoid valve, the electrical power supply to which is controlled by the P4/PF switch.

An additional H.P. delivery supply can be selected to further enrich the primary supply during starting. This fuel supply is controlled by a fuel enrichment solenoid, the electrical power supply to which is controlled by the fuel and ignition switch.

R B. Speed or Speed and Temperature Limiting System Description

R The system comprises a speed or speed and temperature control amplifier and an N2 speed switch.

The limiting system functions to override the fuel scheduling set by the F.F.R. to prevent the maximum values of the parameters sensor being exceeded.

This is achieved by the amplifier controlling the positioning of the variable restrictor and therefore the
R pressure drops sensed by the trim valve. Thus the amplifier can cause the trim valve to move and override
R the fuel flow scheduled by the F.F.R.

R Two types of amplifier are used on the RB211. The combination
R of these units form two standards of limiting systems as
R follows:

Amplifier STA.103 (includes an N2 speed switch) - Controls maximum N2 and T.G.T.
R Amplifier SCA.200 - controls maximum N2

Maximum N2 and T.G.T. Limiting System (Amplifier STA.103)

R Refer to fig.2 (sheet 1). Signals of N2, from the I.P. speed probes and signals of T.G.T. from the T7 thermocouples are connected to the amplifier.

The amplifier basically comprises a speed channel and a temperature channel which monitor the signals sensed. If either of the signals exceed preset datums, the amplifier output stage is triggered to connect an electrical supply to the variable restrictor actuator to move the restrictor towards the max. trim position.

This causes the pressure drop across the trim valve to become unbalanced and the valve closes to restrict fuel flow to the F.F.R.

The subsequent decrease in engine speed and temperature reduces the overdatum signal sensed by the amplifier and the output stage is triggered to rotate the variable restrictor towards the 'no trim' position.

The units are not interchangeable between each system and to prevent incorrect installation a colour identification is used as follows:

R Amplifier STA.103, SCA200 and associated wiring are colour coded blue.

The change in pressure drop is sensed by the trim valve which opens and fuel flow is again scheduled to the P4/P1 ratio set by the F.F.R.

If an overdatum N2 signal is sensed the amplifier initiates fuel trimming as described. If however the increase in N2 is such that the electronic speed switch datum setting is reached (approximately 4% N2 above speed channel datum) the electronic speed switch circuit is activated. This connects a positive 8 V dc supply to the output stage error input supply. This registers as a large overdatum signal and the output stage is held open longer to provide high speed variable restrictor rotation to the max trim position.

When N2 decreases subsequent to fuel trimming, the speed switch is deactivated to 'break' the low voltage circuit. The N2 level at which this occurs is lower than that at which the speed switch is activated to prevent hunting around the datum setting.

For a more detailed description of the amplifier refer to para.D.

R Maximum N2 (SCA.200 Amplifier) Limiting System.

R Refer to Fig.2 (Sheets 2 to 3). Signals of N2 from the I.P.
R speed probes are connected to the amplifier.

R The SCA.200 amplifier basically comprises an N2 speed channel
R which monitors the signal sensed, an error selection unit
R and an output stage. Under normal operating conditions the
R N2 signal is amplified, processed through a highest wins gate
R and the output used to drive the trim valve actuator.

R As the datum for the amplifiers is set above the normal
R operating level, a below datum signal will be sensed when the
R engine is operating normally and the trim valve actuator will
R drive the trim valve to the no trim position.

R If the N2 signal, exceed the preset datum, the output from the
R highest wins gate drives the trim valve actuator towards the
R maximum trim position. This causes the pressure drop across
R the trim valve to become unbalanced and the trim valve closes
R to restrict fuel flow to the fuel flow regulator (F.F.R.).

R The subsequent decrease in speed, temperature, reduces the
R overdatum signal sensed by the amplifier, the output from the
R highest wins gate then drives the trim valve actuator towards
R the no trim position. The change in pressure drop is sensed
R by the trim valve which moves to the no trim position and fuel
R flow is again scheduled to the P4/P1 ratio set by the F.F.R.

R In the event of a F.F.R., Variable Inlet Guide Vane (V.I.G.V.)
R airflow control unit malfunction, or any engine malfunction
R which results in a rapid and excessive increase in engine
R speed, an additional N2 overspeed signal is provided to the
R highest wins gate. This acts to rapidly reduce engine speed
R and when engine speed is sufficiently reduced, the normal
R N2 limiting control channel assumes control.

R For a more detailed description of the amplifier refer to
R para.D.

C. Fuel Flow Regulator

The fuel flow regulator is located in zones 412, 422 and 432 on the rear face of the high-speed external gearbox from which the drive for the unit rotating assemblies is taken.

The unit comprises two sub-assemblies, the fuel regulator and the pressure ratio control.

Fuel Regulator

The fuel regulator (Ref. fig.1) meters the fuel flow to the spray nozzles, consistent with the requirement determined by the pressure ratio control, to support the power selected by the throttle lever.

The regulator comprises a variable metering orifice assembly, its associated capsule assembly and a pressure drop governor and flyweight assembly.

The metering orifice assembly consists of a ported hollow plunger that operates in a ported sleeve. H.P. fuel is metered as it passes through the plunger ports, the flow areas of which are controlled by the positioning of the plunger relative to metering edges incorporated on the sleeve. The plunger is moved by a capsule assembly consisting of two capsule stacks. The capsules, one of which is evacuated and the other subject internally to P3, are housed in a chamber into which KP4P is delivered. To achieve optimum response of the metering orifice during acceleration and deceleration an attenuator is fitted in the air supply passage to the P3 capsule. The attenuator slows down the rate of change in P3 sensed by the capsule, relative to the rate of change in KP4P surrounding it.

Plunger movement is limited by two stops. The adjustable maximum stop (maximum V.M.O. stop) limits the maximum fuel flow through the metering orifice to prevent the engine being over stressed at high forward speed at low altitude. To facilitate ground testing the stop incorporates a manual device which, when operated, lowers the control setting of the stop.

The non-adjustable minimum stop (minimum V.M.O. stop) incorporates a solenoid which, when energized, withdraws the stop. In the normal position, the stop ensures that the engine offtake air available, is sufficient for aircraft demands at altitude, by limiting the minimum fuel flow through the metering orifice. During engine starting the solenoid is energized to withdraw the stop, thus allowing the minimum metering orifice area to decrease and prevent overfuelling during altitude starting. The solenoid is de-energized by the N3 speed switch when the engine reaches a predetermined speed on engine without S.B.71-4176 or with S.B.71-5474, and by the P4/PF switch on engines with S.B.71-4176, and the stop is returned to its normal setting by a spring.

A by-pass incorporated in the regulator connects inlet fuel pressure to the downstream side of the V.M.O. Fuel flow through the by-pass is adjusted during initial unit test to achieve basic flow calibration. On units with
R S.B.73-5407 on additional V.M.O. by-pass, parallel with the adjustable by-pass, is introduced to prevent engine run down/flame on deceleration during taxi-ing.

The pressure drop governor controls the pressure drop across the variable metering orifice and therefore the fuel regulator, at a value that is approximately constant.

This pressure drop is sensed by a transducer (73-38-00) that provides signals to a data acquisition unit (31-32-00).

The governor consists of a plunger operating in a ported sleeve, and a flyweight assembly.

The main fuel flow to the spray nozzles passes through the sleeve ports, the flow areas of which are controlled by the positioning of two metering edges on the plunger.

The flyweight assembly consists of a rotating carrier with three flyweights the arms of which act upon a collar on the governor plunger.

The position of the plunger in the sleeve is determined by the force generated by the flyweights (proportional to N3) opposing the force generated by the fuel pressure drop across the variable metering orifice (Ref. fig.3). Therefore, movement of the metering orifice will cause the governor to move and increase or decrease fuel flow to re-establish the pressure drop across the metering orifice. Through the action of the flyweights the rate of this change in fuel flow will be proportional to N3.

To prevent fuel entering the external gearbox in the event of an internal seal failure, the drive coupling area is connected by internal drillings and an external tube to the
R drains mast fairing (Ref. 71-70-00).

Pressure Ratio Control

The pressure ratio control (Ref. fig.3) basically comprises an adze trimmer assembly, an air throttle assembly, a plate valve restrictor and control bellows, and a fixed air potentiometer. It determines the value of KP4P acting on the variable metering orifice capsule assembly to position the metering orifice and schedule fuel flow consistent with the power selected.

KP4P is established by passing P4 through the fixed air potentiometer and its value is determined by the position of the plate valve restrictor. The plate valve restrictor is positioned by two bellows, one evacuated and the other, the control bellows, subjected internally to P4J. Both bellows are housed in a common chamber and surrounded by P1. P4J is established by passing P4 through the adze controlled restrictor and the air throttle multi-hole restrictor.

Filters in the system clean the P4 air to the air throttle assembly (large filter), fixed potentiometer (small filter) and P4P air to the plate valve restrictor.

The adze assembly comprises an evacuated bellows that is surrounded by P1. Movement of the bellows is transmitted to the adze trimmer that moves across a restrictor. In this way the flow of P4 is decreased with increasing altitude to adjust the P4/P1 ratio, set by the air throttle, with P1 and automatically effect the adjustment in power required during climb.

The air throttle assembly comprises a multi-hole restrictor positioned downstream of the adze restrictor. P4 flow through the restrictor is controlled by a throttle valve that passes across the face of the restrictor. The throttle valve is moved by a cam attached to the air throttle lever which in turn is connected by a cable and linkage system to the flight station throttle lever and reverse thrust select lever.

Movement of the air throttle lever is sensed by a transducer (73-38-00) that provide signals of angular position to a data acquisition unit (31-32-00).

The pressure ratio control also incorporates an idle orifice and a ground idle reset solenoid valve which together form a throttle by-pass. When the air throttle is set at the idle position the throttle valve covers the multi-hole restrictor and P4J vents only through the by-pass. Therefore any variation in the by-pass area results in a change in idle power.

The idle reset solenoid valve comprises of a valve, spring loaded in the open position, and a solenoid. When energized the solenoid moves the valve against the spring and reduces the throttle by-pass area. This action causes P4J to increase which results in idle power reducing to the ground idle setting. The electrical power supply to the solenoid is controlled by switches operated by the throttle levers, reverse thrust select levers and the air/ground sensing system. This arrangement ensures that the reduced idle power can be obtained only when the aircraft is on the ground. When the reverse thrust lever is moved to the reverse idle position the solenoid is de-energized and the engine accelerates to flight idle. The solenoid is also de-energized when the throttle lever is advanced beyond a predetermined position.

Adjusters, positioned around the unit as illustrated in 71-00-00 (Adjustment/Test) enable adjustment of the following to be made:

Engine idle speed
Acceleration time
Deceleration time
Maximum power (P4/P1 ratio)
Maximum V.M.O. area

The idle, acceleration and deceleration adjusters incorporate an outer sleeve around the friction locked adjuster which is shimmed, on initial unit test, to bring the top of the sleeve level with the outer end of the adjuster. By establishing the distance the adjuster has been screwed in or out, it is possible on unit replacement to pre-set the new unit to the original settings of the old unit.

The idle adjuster (Ref. fig.3) controls the flow area of the idle orifice. Adjustment of the amount of air venting through the orifice varies the value of P4J and consequently the positioning of the plate valve restrictor, to schedule fuel flow and achieve the required idle power/speed.

The acceleration and deceleration adjusters (Ref. fig.3) limit the travel of the plate valve restrictor lever. Adjustment of these stops vary the rate at which KP4P is allowed to increase or decrease, consequently controlling the acceleration and deceleration times of the engine.

The maximum power adjuster (Ref. fig.3) alters the position of the throttle valve pivot. This enables the area of the multi-hole restrictor uncovered by the air throttle to be varied at any throttle lever setting except idle when the restrictor is completely covered. In this way the maximum power of the engine for any throttle lever setting can be adjusted and throttle lever stagger between engines reduced.

The maximum V.M.O. stop limits the travel of the variable metering orifice rocker lever (Ref. fig.1) and consequently the maximum flow area attainable. The control setting of the stop cannot be tested unless the reset device is operated. Therefore, it is imperative that adjustment of the stop be made only when the reset is operated.

D. Speed and Temperature Control Signal Amplifier

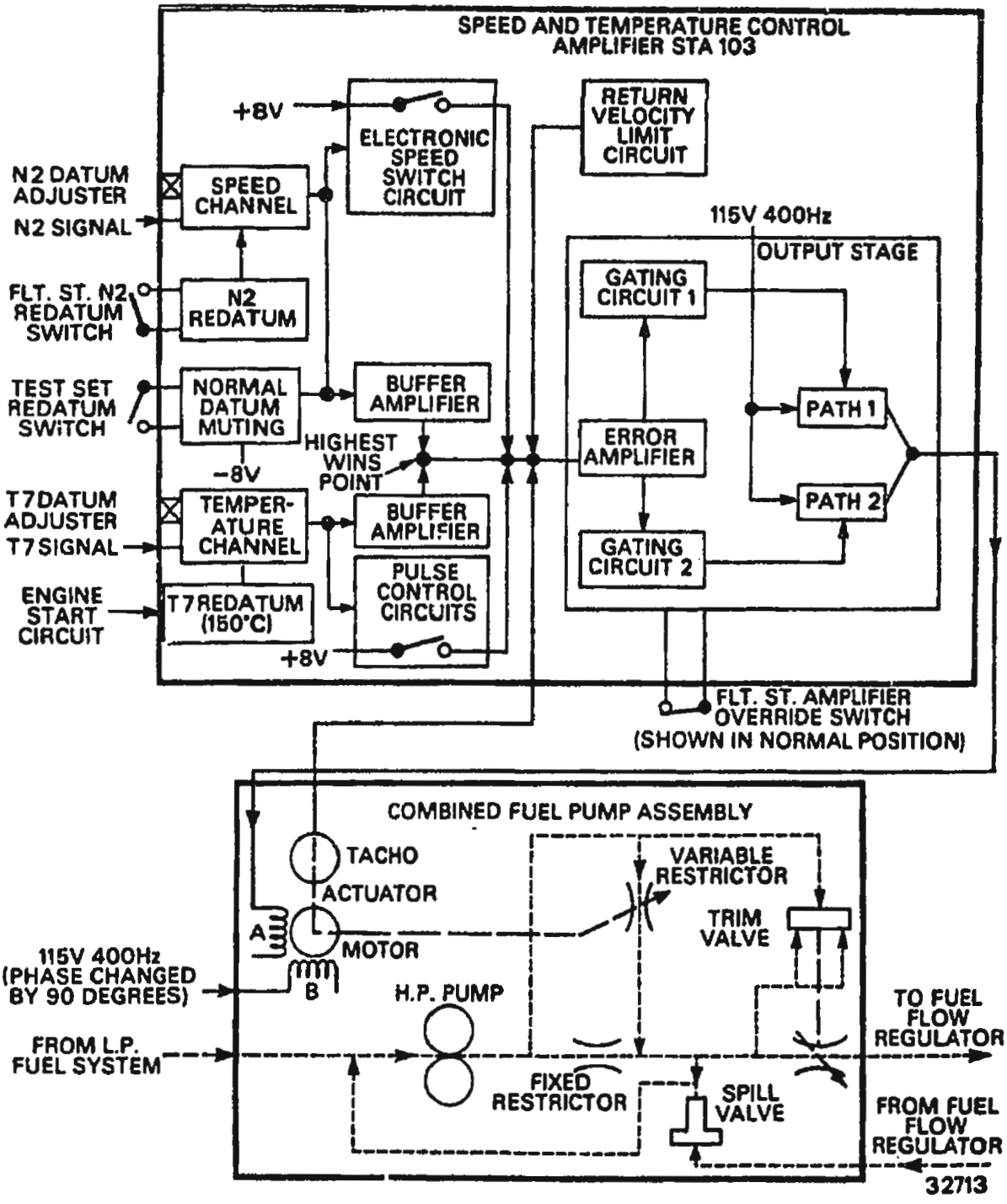
R Two types of amplifiers are currently used on the RB.211. The S.T.A.103 amplifier controls T.G.T. and N2 (and incorporates a fast response control to cater for rapid increases in N2).

R The SCA.200 amplifier controls maximum N2 and incorporates a
R fast response to cater for rapid increases in N2.

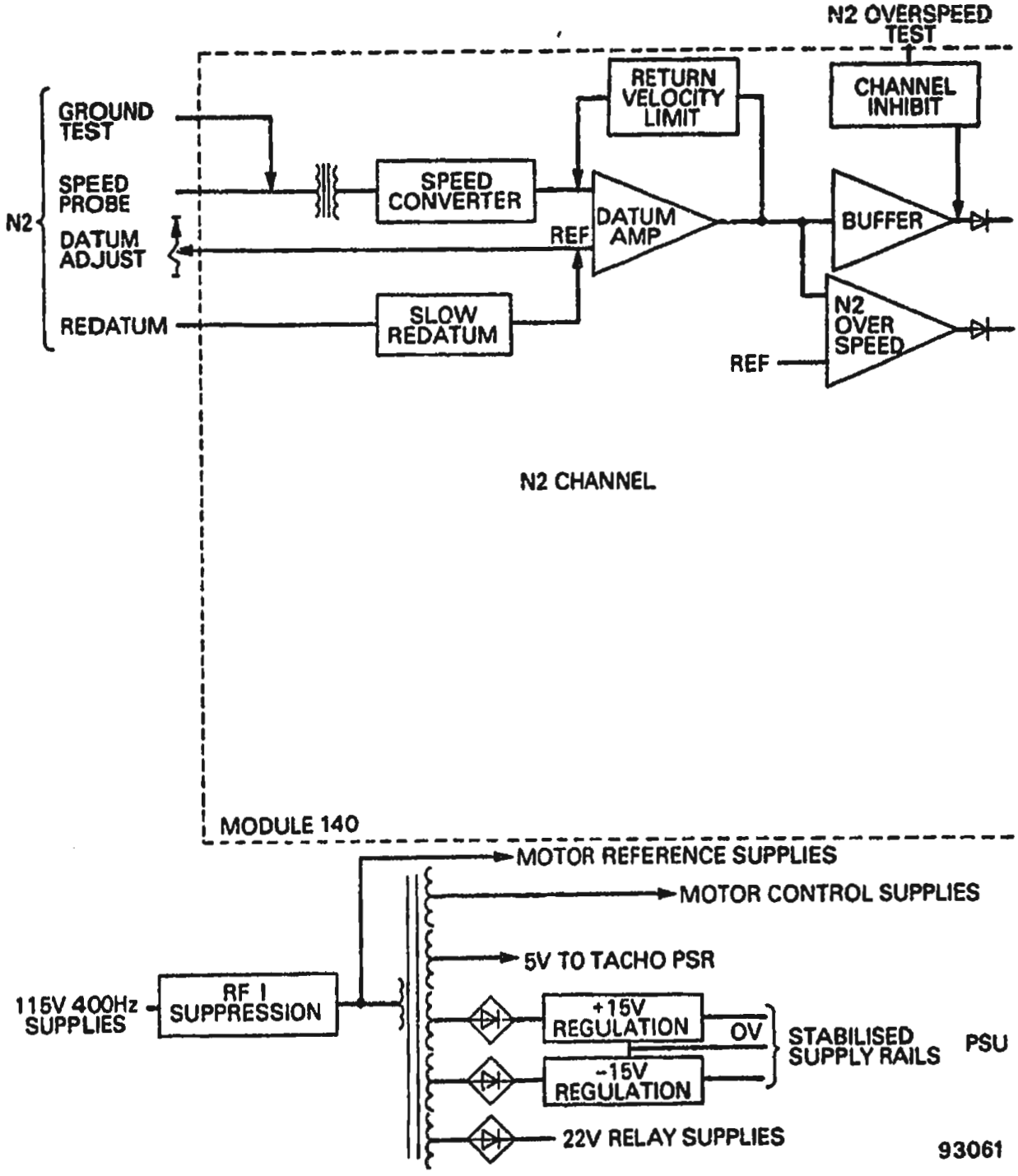
Either amplifier is located in zones 412, 422 and 432 on the upper left-hand side of the L.P. compressor case. Electrical power and signals of speed and temperature are supplied to the unit through connectors mounted on the front face of the unit case.

R To ensure that the correct amplifier is fitted to its
R compatible engine installation, the STA.103 and SCA.200
R amplifiers and associated harnesses are colour coded blue.

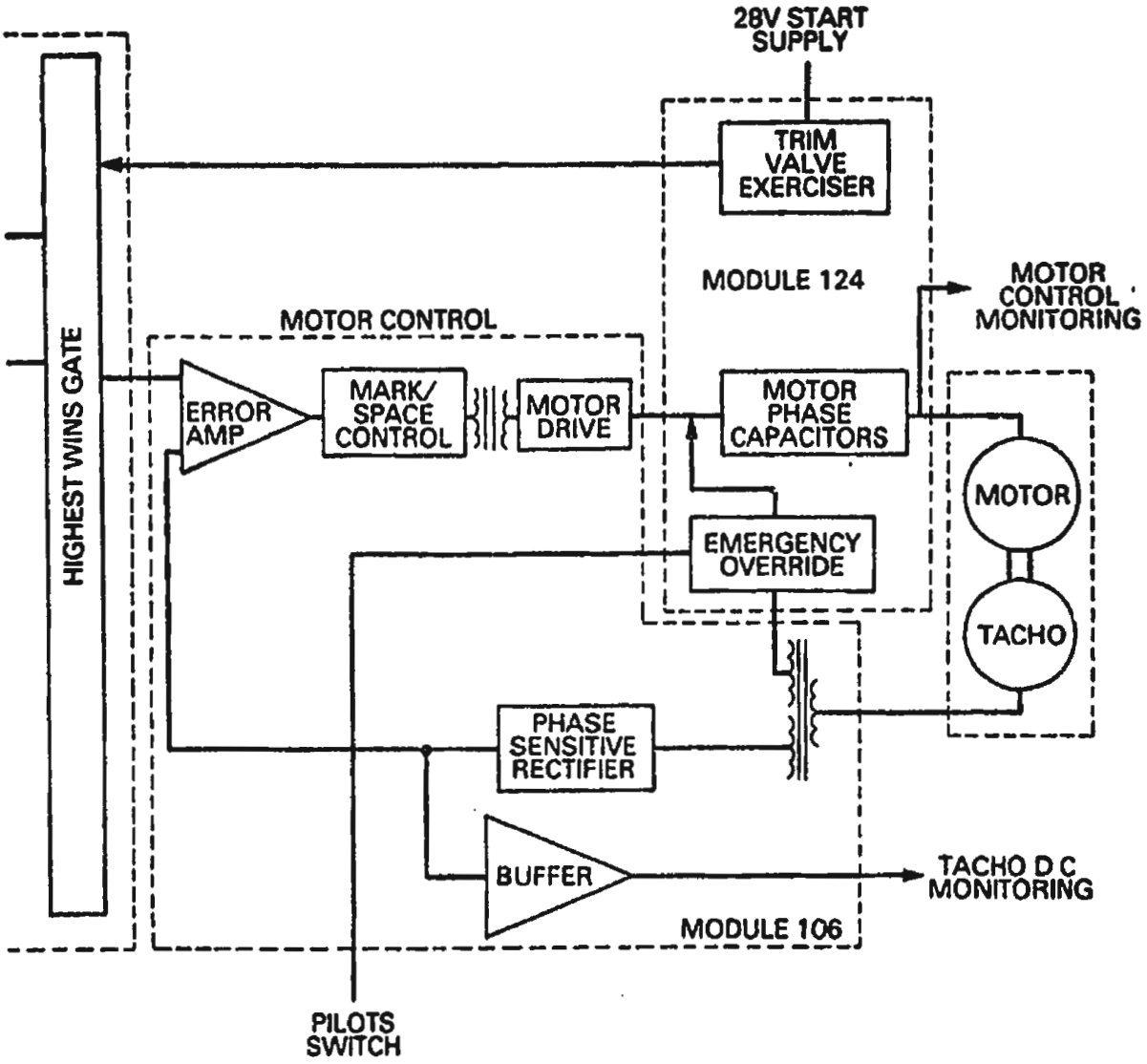
Each amplifier functions to instigate the trimming of fuel flow to the fuel flow regulator whenever the signals sensed, reach a predetermined maximum.



Maximum speed and temperature limiting system diagrammatic layout (STA 103 amplifier)
Fig.2 (Sheet 1)



R Maximum speed limiting system diagrammatic layout (SCA.200 amplifier)
R Fig.2 (Sheet 2)



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R Maximum speed limiting system diagrammatic layout (SCA.200 amplifier)
R Fig.2 (Sheet 3)

STA.103 Amplifier (S.B.71-3641)

R The control amplifier, illustrated in fig.2 (Sheet 1), basically comprises a speed channel, a temperature channel, a highest wins circuit and an output stage.

The unit receives signals of T7 from the T.G.T. indicating system (Ref. 77-21-00) and signals of N2 from the engine shaft speed indicating system (Ref. 77-12-00).

Speed Channel

Signals of N2 are fed into the speed channel where they are amplified, compared with a reference voltage and processed to produce d.c. error signals. Under normal operating conditions the error signals voltage is slightly negative but changes to positive when the channel datum level is reached. The error signals are fed to the highest wins point in the highest wins circuit.

The error signals from the speed channel are also fed to the electronic speed switch circuit. This circuit functions to provide high speed variable restrictor actuator rotation to the maximum fuel trim position should the signals sensed reach a second datum level, approximately 5% N2 above the speed channel datum. When activated the speed switch connects a positive voltage to the input of the error amplifier in the output stage.

Temperature Channel

Signals of T7 are fed into the temperature channel where they are cold junction compensated, compared with a reference voltage and processed to produce d.c. error signals. Under normal operating conditions the error signal voltage is slightly negative but changes to positive when the channel datum level is reached. The error signals are fed to the highest wins point and also monitored by the pulse control circuits.

The pulse control circuits are set to operate just above the temperature channel datum. When activated the pulse circuits emit a positive voltage pulse to the input of the error amplifier. This pulse of approximately one tenth of a second duration, produces some 5 revolutions of the variable restrictor actuator to increase the initial response to an over temperature condition.

Once the pulse has fired, futher pulses are prevented by the circuit being unable to reset until the T7 signals have reduced below the datum level and the actuator is stalled on the no trim stop.

The temperature channel also incorporates a redatum circuit that is energized automatically by the engine starting system. When energized the circuit lowers the datum setting to approximately 150 degrees C. (On units with
R S.B.73-4027 the datum is lowered to approximately minus 200 degrees C.) thus producing positive error signals during engine starting. The amplifier output stage reacts to the error signals and causes the fuel pump variable restrictor actuator to rotate to the maximum trim position. This has no affect on fuel flow during the starting sequence and is effected only to exercise the actuator and variable restrictor. The redatum circuit is automatically de-energized at approximately 46% N3 causing the datum setting to return to normal and the actuator to return to the no trim position.

Highest Wins Circuit

The highest wins circuit basically comprises two buffer amplifiers through which the error signal outputs from the speed and temperature channels are fed to a common highest wins point. The circuits are arranged so that should positive voltage error signals be received from both the speed and temperature channels simultaneously the dominant signal biases off the weaker signal; the dominant signal passing unhindered to the output stage. This arrangement prevents the summing of error signals thus avoiding excessive fuel trimming.

Output stage

The output stage basically comprises an error amplifier that controls two gating circuits which in turn control two output paths to the fuel pump variable restrictor motor windings A.

The error amplifier receives the output from the highest wins circuit. When the error signals are negative the error amplifier operates gating circuit 2 to open output path 2 to the actuator. Conversely when the error signals are positive (over datum condition) the error amplifier operates gating circuit 1 to open path 1. The duration that the paths remain open and consequently the speed of rotation of the actuator is dependent on the amplitude of the error signal.

The two output paths are fed with 115 V 400 Hz electrical supply, phase reversal of 180 degrees occuring in one path. Therefore as the actuator windings are fed with 115 V 400 Hz electrical supply phase changed by 90 degrees, the output from the amplifier fed to windings A will either lead or lag the supply fed to windings B, depending on which path is open.

The difference in phase of the electrical supplies connected to windings A and B creates a rotating magnetic field to rotate the actuator.

Return Velocity Limit Circuit and Actuator Velocity Feedback.

The return velocity limit circuit senses the output from the highest wins circuit. The circuit functions to limit the speed of rotation of the variable restrictor actuator to the no trim position to avoid limit cycling of the trim system.

The actuator velocity feedback is provide by a tacho-generator built into the actuator. The a.c. signals produced are fed back to the amplifier where they are rectified to produce d.c. signals whoes amplitude is proportional to actuator speed, and polarity is determined by the direction of actuator rotation. These signals are fed to the error amplifier, where they summed with the output from the highest wins circuit, to provide control stability.

Adjustment and Test Features

To facilitate ground testing the control amplifier is connected to the engine ground test connectors. This allows for the input of simulated T7 and N2 signals to enable to datum settings of the speed and temperature channels to be tested. To enable the speed switch datum to be tested the normal N2 datum setting can be muted from the test set.

The control amplifier is also connected to two flight station switches. One enables the amplifier to be overridden in the event of a malfunction and the other redatums the N2 channel to enable the system to be tested.

When operated the override switch breaks the electrical supply to a relay in the output stage which cause a 115 V 400 Hz electrical supply to be connected to the actuator to rotate the variable restrictor to the no trim position irrespective of any error signals present in the system.

The flight station redatum switch when operated de-energizes a relay which slowly lowers the speed channel datum setting. This causes the output from the channel to become positive at a lower N2 to enable the action of the system to be tested.

Adjusters positioned on the front face of the control amplifier case enable the normal datum settings of both channels to be adjusted.

R SCA.200 (S.B.73-7620) Amplifier

R The fuel control amplifier (Ref. Fig.2 Sheets 2 to 3)
R basically comprise a speed channel (N2), an error selection
R unit and an output stage.

R The units receive signals of N2 from the I.P. probes in the
R engine shaft speed indicating system (Ref.77-12-00).

R Speed Channel

R The N2 signals are processed through a speed converter into
R a form for comparison with the N2 channel preset datum
R reference, generated within the amplifier. The signals are
R fed to the highest wins gate on a highest wins basis.

R In the event of a F.F.R., Variable Inlet Guide Vane (V.I.G.V.)
R airflow control unit malfunction or any engine malfunction
R which results in a rapid and excessive increase in engine
R speed, an additional N2 overspeed signal is provided to the
R highest wins gate. This acts to rapidly reduce engine speed
R and when engine speed is sufficiently reduced, the normal N2
R limiting control channel assumes control.

R Output Stage

R The error at the highest wins gate is fed into an error
R amplifier, where it is summed with a negative feedback
R voltage derived from the motor tacho-generator signal. The
R resultant error from the error amplifier, is applied to a
R mark/space control which proportions the mark-to-space ratio
R according to the magnitude of the error.

R The motor drive stage has two parallel circuits that are
R switched 'On' in turn, by pulses of approximately 8Hz from
R the mark/space control. The circuits switch current from
R the 400 Hz supply through rectifier bridges to the motor
R control winding.

R As the datum for the amplifier is set above the normal
R operating level, a below datum signal will be sensed when the
R engine is operating normally, the trim valve actuator will
R drive the variable orifice to the no trim position.

R If the N2, exceed preset datums, the output from the highest
R wins gate drives the trim valve actuator towards the maximum
R trim position. This causes the pressure drop across the trim
R valve to become unbalanced and the trim valve closes to
R restrict fuel flow to the F.F.R. thus increasing the pressure
R drop sensed by the spill valve. The spill valve opens to
R spill fuel back to the H.P. pump inlet.

R The subsequent decrease in speed, reduces the over datum
R signal sensed by the amplifier, the output from the highest
R wins gate then drives the trim valve actuator towards the no
R trim position. The change in pressure drop is sensed by the
R trim valve which opens and fuel flow is again scheduled to the
R P4/P1 ratio set by the F.F.R.

R Pilots Override Facility

R A flight station switch located in zone 215, allows the
R amplifier to be overridden in the event of a malfunction.
R With the switch in the open circuit position, the trim valve
R actuator is energised to move the variable orifice to the
R no trim position, irrespective of any error signals in the
R system.

R Return Velocity Limiter

R The return velocity limit circuit senses the output from the
R highest wins gate. The circuit functions to limit the speed
R of rotation of the trim valve actuator to the no trim
R position, to avoid limit cycling of the trim system.

R A return velocity limiter is provided in the N2 speed channel
R to restrict the return velocity of the actuator motor. This
R is achieved by a comparator sensing the error signal present
R at the highest wins gate that is causing the reduction in
R fuel flow.

R With the actuator motor rotating at approximately 280 R.P.M.
R the error signal voltage is clamped, thus preventing any
R further increase in the trim valve actuator speed.

R Trim Valve Exerciser

R The system incorporates a trim valve exerciser that operates
R automatically during engine starting. A high input is
R injected to the highest wins gate, causing the actuator to
R drive the trim valve to the maximum trim position at full
R speed, thus ensuring that movement is not impeded. The trim
R valve exerciser is automatically disengaged after engine
R light up, the trim valve returns to the no trim position at
R the return velocity speed.

R Adjustment and Test Features

R To facilitate ground testing, the fuel control amplifier is
R connected to the engine ground test connectors. This allows
R for the input of simulated N2, signals, to enable the datum
R settings of the speed channels to be tested.

R Adjusters positioned on the front face of the fuel control
R amplifier case enable the N2, datum channels to be adjusted.
R Turning an adjuster in a clockwise direction (viewed from the
R front face of the amplifier) increases the datum setting.

R An overspeed test switch is provided to enable the overspeed
R datum to be tested. The test switch inhibits the N2 channel
R by removing normal control at the highest wins gate, so
R allowing the normal datum to be exceeded and facilitate
R testing of the overspeed datum.

R The flight station amplifier test switch enables the speed
R channel datum to be tested. Operation of the switch
R de-energises a relay which slowly lowers the speed channel
R datum setting. This allows the system to be tested at a
R lower datum setting.

D. Starting Fuel Flow Regulator

The starting regulator (Ref. fig.3) is located in zones 412, 422 and 432 on the left-hand side of the L.P. compressor case and basically a solenoid operated valve and two fixed flow area orifices.

The unit controls fuel flow during engine starting and also, through the interaction of the solenoid operated valve with the starting control system, the unit allows a supply of H.P. delivery fuel to enrich the primary supply from the fuel flow regulator.

On engines without S.B.71-4176 or without S.B.71-5474 the enrichment solenoid is de-energized by the P4/PF switch when the engine reaches a predetermined pressure ratio and the valve shuts off the enrichment fuel supply.

On engines with S.B.71-4176 or S.B.71-5474 the enrichment solenoid is de-energized by the N3 indicator 51% speed switch.

The primary fuel flow area is set during calibration by adjusting the orifice relative to a fixed stop screw. The enrichment flow area orifice is set during calibration by the positioning of a plate valve relative to the orifice. Adjustment of the push rod position varies the positioning of the plate valve.

Maintenance adjustment of the enrichment flow is permitted on Mk.6m Mk.7 and Mk.11 units only.

E. P1 Probe

The P1 probe is located in zones 312, 411 and 421 and senses the air pressure entering the L.P. compressor. The pressure sensed by the probe is directed, as a pressure signal, to the fuel flow regulator and the integrated engine pressure ratio transmitter.

The probe comprises a pitot tube, housed in a fabricated body of aerodynamic shape. The assembly is secured to the inner skin of the air intake, at the top position, forward of the L.P. compressor inlet.

Anti-icing of the probe is effected through a tube that connects with a tapping in the air inlet anti-icing air duct (Ref. 30-21-00).

F. Fuel Enrichment Solenoid

The fuel enrichment solenoid is located in zones 412, 422 and 432. The unit basically comprises a solenoid operated valve and return spring mounted in a case secured to the H.P. shut-off valve. The inlet and outlet ports for the unit are incorporated in the H.P. shut-off valve case as shown in 73-11-00 fig.3.

The electrical supply to the solenoid is controlled by the fuel and ignition switch located in the flight station (zone 210).

When energized, the solenoid withdraws the valve which allows H.P. pump outlet fuel to enrich the primary fuel supply (engines not incorporating S.B.73-4592) to the starting flow regulator.

On engines incorporating S.B.73-4592, the solenoid when energized withdraws the valve which directs H.P. delivery into the main fuel supply pressure sensing to pressure drop spill valve line, down stream of the starting fuel flow regulator.

G. P4/PF Pressure Ratio Switch

The P4/PF switch is mounted on the engine firewall in zones 412, 422 and 432. The unit functions on engines without S.B.71-4176 or without S.B.71-5474 to de-energize the starting flow regulator solenoid valve at a predetermined P4/PF ratio. On engines with S.B.71-4176 the switch controls the electrical supply to the fuel flow regulator minimum V.M.O. solenoid.

On engines with S.B.71-5474 the switch controls the electrical supply to the H.P. compressor left-hand bleed valve control unit.

The switch (Ref. fig.3) basically comprises a pressure diaphragm, a spring loaded microswitch and a fluidic element housed in a case. The case incorporates an electrical receptacle and an integral mounting flange. Air supplies for the fluidic element are connected to the unit through two unions. The P4 union incorporates a filter and two restrictors and the PF union incorporates a filter only.

P4 air entering the switch is passed through the two restrictors to produce a pressure PS which vents to the PF inlet through a venturi incorporated in the fluidic element.

The characteristics of the fluidic element are such that PS is directed towards either the P01 or P02 outlet. The path taken by the airflow being dependent on the control pressures PR and PF. As PR is a function of PS (restricted P4) passing through the venturi, the point at which airflow is deflected from one outlet to the other can be related to a specific P4/PF ratio.

The outlet P01 and P02 are connected through internal drillings to either side of the switch diaphragm which controls the opening of the microswitch.

On commencement of engine starting the pressure difference PF minus PR diverts PS towards the P02 outlet maintaining the diaphragm in the microswitch 'closed' position. The microswitch is held closed by the spring thus connecting the electrical supply to the starting regulator solenoid and the valve opens to allow H.P. fuel to enrich the primary fuel flow.

At a predetermined P4/PF ratio, prior to reaching flight idle, the increasing PS chokes the venturi causing a rapid increase in PR. The pressure difference PR minus PF then diverts PS towards the P01 outlet to deflect the diaphragm and open the microswitch.

On engines with S.B.71-4176 this action de-energizes the min V.M.O. solenoid and the stop returns to its normal setting.

On engines without S.B.71-4176 or S.B.71-5474 this action de-energizes the starting fuel flow regulator enrichment solenoid and cancels the starting enrichment fuel flow.

On engines with S.B.71-5474 this action de-energizes the H.P. compressor left-hand bleed valve control unit and the left-hand bleed valve closes (Ref.75-32-00).

H. Air Tubes

The air supplies to the fuel flow regulator and the P4/PF switch are delivered through rigid tubes.

The P1 air tube is connected to a pick-up connector, located on the rear diaphragm of the nose cowl, which connects to the P1 probe.

The P3 air tube is connected directly to an air tapping on the lower right-hand side of the intermediate compressor case.

The P4 air tube is connected to the fuel cooled P4 air cooler (Ref. 73-11-00) which is connected to tappings in No.15 and No.17 spray nozzle flanges.

The PF air tube is connected to the fuel cooled P4 air cooler which receives PF air from an aperture through the L.P. compressor case.

3. Operation

A. Starting - ground start

Due to the pressure acting on the evacuated capsules and bellows of the control system the variable metering orifice is held off the minimum V.M.O. stop and, the plate valve restrictor is held on the acceleration stop. The idle reset solenoid valve will be energized to close the valve thus reducing the throttle by-pass area to set the idle power to the reduced setting (ground idle).

On initiation of engine starting the following sequence occurs.

The starting regulator solenoid is energized to allow H.P. delivery fuel to enrich the primary fuel flow and the minimum V.M.O. stop solenoid is energized to withdraw the stop.

As in these conditions the variable metering orifice is not in contact with the minimum V.M.O. stop, the action of withdrawing the stop during the starting cycle does not affect fuel flow.

As engine shaft speed is low the pressure drop governor is closed by the force created by the fuel pressure drop across the metering orifice, thus directing all fuel flow through the primary supply line.

On selection of the flight station fuel and ignition switch to 'ON' the shut-off valve opens and connects the fuel supply to the spray nozzles.

As 'light up' occurs, the increasing flyweight force opens the governor thus allowing fuel flow through the main supply line to the spray nozzles.

As the engine pressures increase, KP4P progressively compresses the metering orifice capsule stack, thus increasing fuel flow to maintain engine acceleration up to idle.

When the P4/P1 ratio reaches the value set by the throttle by-pass, P4J expands the control bellows and moves the plate valve restrictor off the acceleration stop to the balance position. This stabilizes KP4P and therefore fuel flow and increases the pressure drop across the metering orifice.

The pressure drop governor moves towards the closed position until the forces acting upon it balance, thus increasing the overall pressure drop across the fuel regulator.

The spill valve reacts to the change in pressure drop sensed and opens to spill fuel in excess of requirement back to the H.P. pump inlet and the pressure drop across the fuel regulator stabilizes to achieve steady running at the P4/P1 ratio set at idle.

On engines without S.B.71-4176 and without S.B.71-5474 the starting regulator enrichment solenoid remains energized and continues to enrich the fuel flow until the P4/PF switch operates at approximately 68% N3.

On engines with S.B.71-4176 or with S.B.71-5474 the starting regulator enrichment solenoid remains energized and continues to enrich the fuel flow up to 51% N3.

B. Flight start below 14,000 ft.

The starting sequence is the same as a ground start except that the power supply to the idle reset solenoid valve will be cancelled by the air/ground sensing system. This increases the throttle by-pass area and consequently sets the idle power to the higher setting (flight idle).

C. Flight start above 14,000 ft.

Except for the following, the sequence of operations is the same as that described in 3.B.

Due to the reduced pressure at altitude allowing the metering orifice evacuated capsule to expand, the metering orifice is in contact with the minimum V.M.O. stop, thus scheduling a lower starting fuel flow. In consequence, when the minimum V.M.O. stop solenoid is de-energized, it it pushes the metering orifice open and the engine accelerates to a P4/P1 ratio higher than that scheduled by the throttle by-pass.

D. Acceleration from idle to a selected power

Advancing the throttle lever moves the air throttle valve to increase the effective flow area of the multi-hole restrictor, thus decreasing P4J.

The P4J bellows contracts and the plate valve restrictor moves on to the acceleration stop, thus increasing KP4P and the metering orifice flow area.

The governor reacts to the decrease in pressure drop across the metering orifice and opens, thus decreasing the overall pressure drop across the fuel regulator.

The spill valve reacts to the change in the pressure drop sensed and moves to decrease fuel spill, thus increasing H.P. delivery flow to the fuel regulator.

The engine accelerates until, as the power ratio selected by the throttle lever is approached, the increasing P4J expands the control bellows and moves the plate valve restrictor off the acceleration stop towards the balance position. This stabilizes KP4P and the metering orifice area, and the governor moves to re-establish the overall pressure drop across the fuel regulator.

The spill valve moves to increase fuel spill and schedule H.P. delivery flow consistent with the new requirement. The pressure drop across the fuel regulator then stabilizes and steady running conditions are achieved at the power selected.

E. Power flat rating

Under steady running conditions at the power selected, P4J will be at a constant value and the plate valve restrictor will be in the balance position. KP4P will therefore be at a constant value and the pressure drop across the fuel regulator will be stable.

At constant altitude, any variation in the P4/P1 ratio sensed by the pressure ratio control will result in the following:

If the P4/P1 ratio decreases:

The P4J bellows contracts and the plate valve restrictor is disturbed towards the acceleration stop, thus increasing KP4P and the metering orifice flow area.

Fuel flow then increases in a similar manner as described in 3.D. until the P4/P1 ratio is re-established.

If the P4/P1 ratio increases:

The P4J bellows expands and the plate valve moves towards the deceleration stop, thus decreasing KP4P and the metering orifice flow area.

Fuel flow then decreases in a similar manner as described in 3.G. until the P4/P1 ratio is re-established.

In ambient temperature conditions above the specific limit, it may be necessary to restrict flat rating to prevent the engine exceeding T.G.T. or shaft speed limitations.

F. Climb at fixed throttle lever position

At the commencement of climb, the initial power requirement is selected by the throttle lever.

As P1 decreases with altitude, the adze capsule expands and moves the adze knife to decrease the flow area of the adze orifice and vary the P4/P1 ratio, selected by the air throttle lever, with changing P1.

As P4J decreases relative to P1, the plate valve restrictor is disturbed toward the acceleration stop, thus reducing the rate at which KP4P and hence the metering orifice flow area progressively decreases with altitude. This results in fuel flow being scheduled above the normal flat rating level with a consequent increase in P4 and therefore P4J. The increase in P4J expands the control bellows and moves the plate valve restrictor back towards the balance position.

During climb this sequence of operations will result in a progressive increase in P4/P1 ratio, thus achieving the required climb power with little or no throttle lever adjustment.

In ambient temperature conditions above the specific limit it may be necessary to adjust the throttle lever setting to prevent the engine exceeding T.G.T. or shaft speed limitations.

G. Deceleration

Movement of the throttle lever rearwards decreases the effective flow area of the multi-hole restrictor, thus increasing P4J.

The P4J bellows expands and the plate valve restrictor moves onto the deceleration stop, thus decreasing KP4P and the metering orifice flow area.

The governor reacts to the increase in pressure drop across the metering orifice and closes, thus increasing the overall pressure drop across the fuel regulator.

The engine decelerates until the power selected by the throttle lever is approached and decreasing P4J allows the plate valve restrictor to move off the deceleration stop towards the balance position. This stabilizes KP4P and the metering orifice flow area and, due to the decrease in pressure drop across the metering orifice, the governor moves to re-establish the overall pressure drop across the fuel regulator.

The spill valve moves to decrease fuel spill and schedule H.P. delivery flow consistent with the fuel regulator requirement and steady running conditions are achieved at the power selected.

H. Automatic control of maximum permitted speed and temperature
R STA.103 amplifier

If either of the signals sensed by the control signal amplifier produces a positive error in its channel, the amplifier output stage feeds an a.c. supply to the actuator motor stator windings A (Ref. fig.2). The motor rotates and moves the variable restrictor toward the maximum trim position, thereby increasing the pressure drop sensed by the trim valve.

The trim valve reacts to the change in pressure drop and moves towards the closed position, thus decreasing fuel flow to the fuel flow regulator and increasing the pressure drop sensed by the spill valve. The spill valve opens to spill fuel back to the H.P. pump inlet.

The decrease in fuel flow results in the positive error signal being cancelled and the amplifier output stage feeds a signal to the motor stator windings A to rotate the variable orifice towards the 'no' trim position. This decreases the pressure drop sensed by the trim valve and the valve opens. The spill valve reacts to the change in pressure drop sensed and moves to schedule fuel flow to the regulator requirement.

R SCA200 Amplifier

R If an overspeed N2, signal is sensed at the highest wins gate, R the output is fed into an error amplifier (Ref. Fig.2) where R it is summed with a negative feedback voltage derived from R the motor tacho-generator signal. The resultant error from R the error amplifer is applied to a mark space control, which R proportions the mark-to-space ratio according to the magnitude R of the error.

R The motor drive stage has two parallel circuits that are R switched 'On' in turn by pulses of approximately 8Hz from R the mark-space control. The circuits switch current from R the 400Hz supply through rectifier bridges to the motor R control winding.

R The trim valve actuator motor rotates and moves the variable R orifice to the maximum trim position. This causes the R pressure drop across the trim valve to become unbalanced and R the trim valve closes to restrict fuel flow to the F.F.R. R thus increasing the pressure drop sensed by the spill valve. R The spill valve opens to spill fuel back to the H.P. pump R inlet.

R The subsequent decrease in speed reduces the overdatum signal R sensed by the amplifier at the highest wins gate, the output R stage feeds a signal to the mark-space control which causes R the trim valve actuator motor to rotate and move the variable R orifice to the no trim position. The change in pressure drop R is sensed by the trim valve which opens and fuel flow is again R scheduled to the P4/P1 ratio set by the F.F.R.

J. Automatic selection of ground idle power

When the throttle levers are closed prior to touch down the ground idle reset solenoid circuit is armed up to the air/ground sensing system. As the weight of the aircraft is taken on the undercarriage the sensing system energizes the reset valve solenoid. The solenoid moves the valve and reduces the throttle by-pass area.

This increases P4J and the plate valve restrictor moves onto the deceleration stop, thus decreasing KP4P and the metering oririce flow area.

Fuel flow then decreases as described in 3.G. until ground idle power is attained.

Opening the throttle lever beyond a predetermined position or selecting reverse thrust, de-energizes the solenoid and the valve opens.

P4J then decreases and the plate valve restrictor moves off the deceleration stop to increase KP4P and hence fuel flow and the engine power returns to the flight idle setting.

K. Maximum N3 limiter

If N3 reaches its maximum permitted limit the pressure drop created by the fixed restrictor overcomes the trim valve spring and moves the valve towards the closed position, thus decreasing the pressure drop sensed by the spill valve. The spill valve opens to spill fuel back to the H.P. pump inlet and reduces fuel flow to the fuel regulator.

The resulting decrease in engine and therefore pump speed reduces the pressure drop sensed by the trim valve and the spring moves the valve to the open position. The spill valve reacts to the change in pressure drop sensed and moves to schedule fuel flow to the fuel regulator requirement.

L. Reverse thrust

Movement of the reverse thrust select lever to the reverse idle position moves the air throttle lever and also breaks the circuit to the idle reset solenoid. Due to the shape of the air throttle lever cam the air throttle valve does not uncover the multi-hole orifice during transition from forward to reverse idle. De-energizing the reset solenoid allows the spring to open the valve and idle power increases to flight idle.

Further movement of the reverse thrust select lever moves the air throttle valve and increases the effective flow area of the multi-hole orifice. Engine power then increases in the same manner as described in 3.D.

Movement of the reverse thrust select lever from full reverse to reverse idle decreases the effective flow area of the multi-hole orifice and the engine decelerates as described in 3.G. to flight idle.

Movement of the reverse thrust select lever to the forward thrust position energizes the reset solenoid valve and the engine decelerates to ground idle.

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FUEL PRESSURES

- L P delivery
- H P pump outlet
- H P delivery
- Primary fuel supply
- Main fuel supply

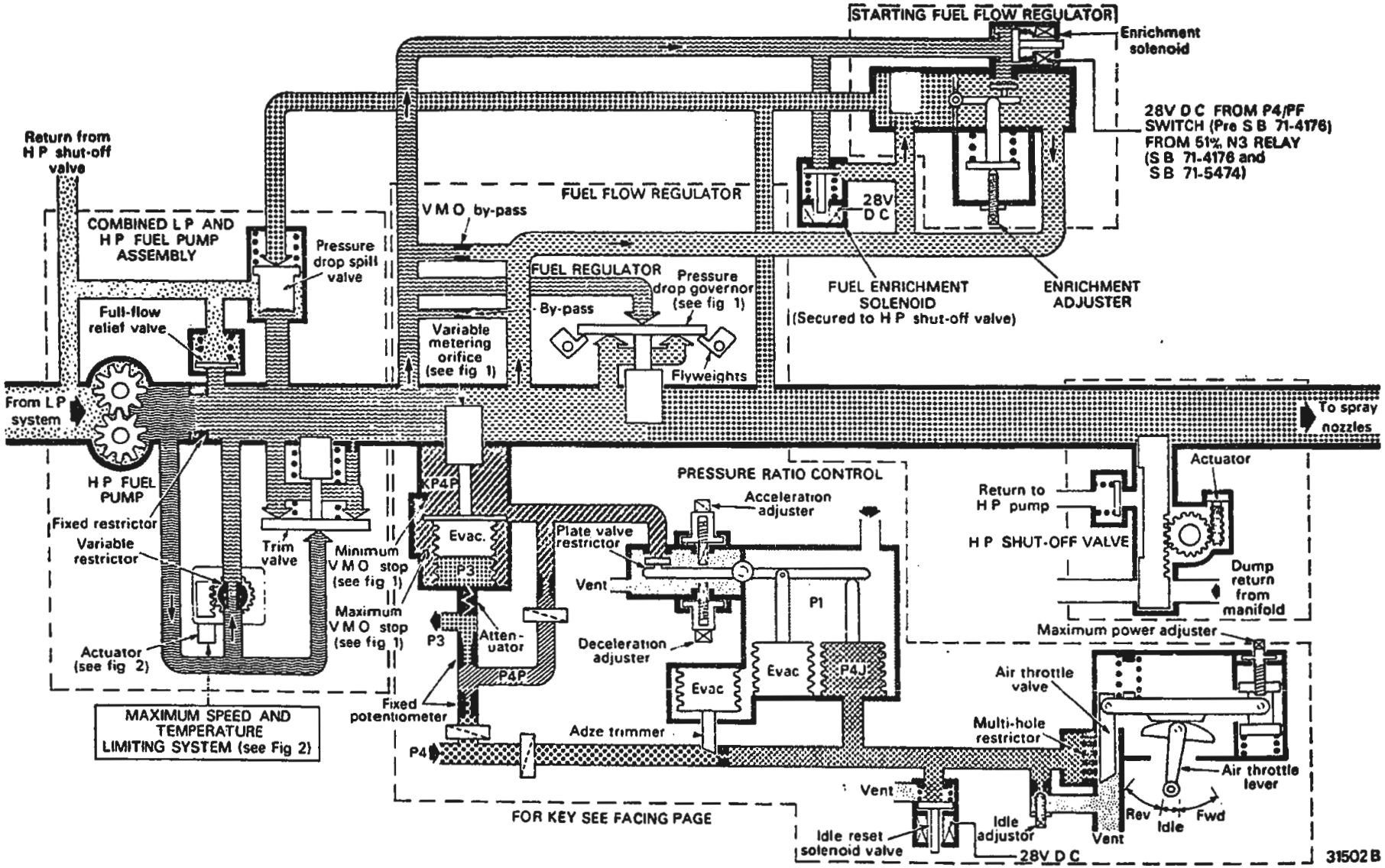
PRESSURE RATIO CONTROL AIR PRESSURES

- PO Ambient
- P1 Engine inlet
- P3 H P compressor inlet
- P4 H P compressor delivery
- P4P (Potentiometered P4 and P3)
- P4J (Potentiometered P4)
- KP4P (Restricted P4P discharging through plate valve restrictor)

- CONDITION SIGNAL
- CONTROL SIGNAL
- FILTER

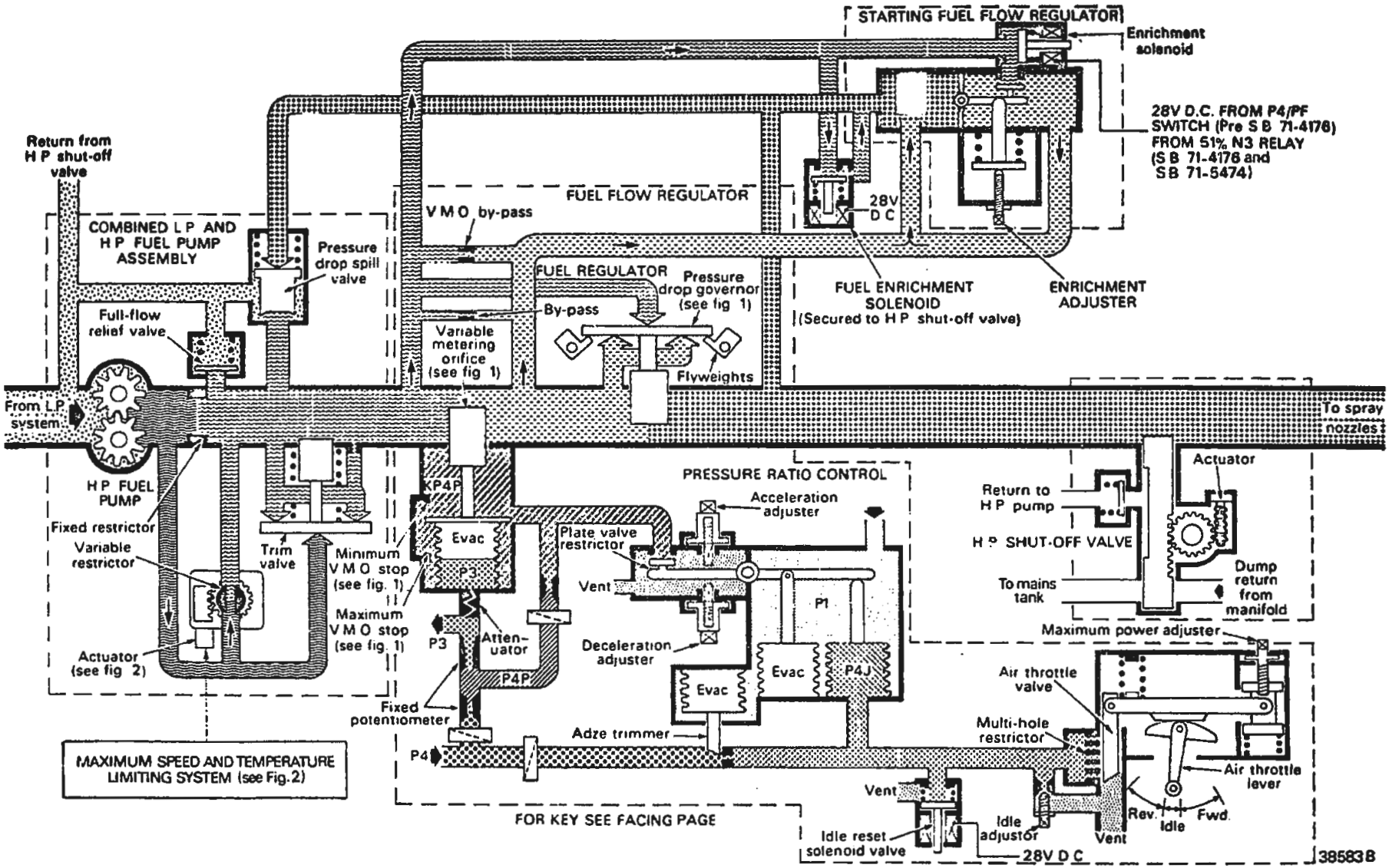
44775

Key to fig.3



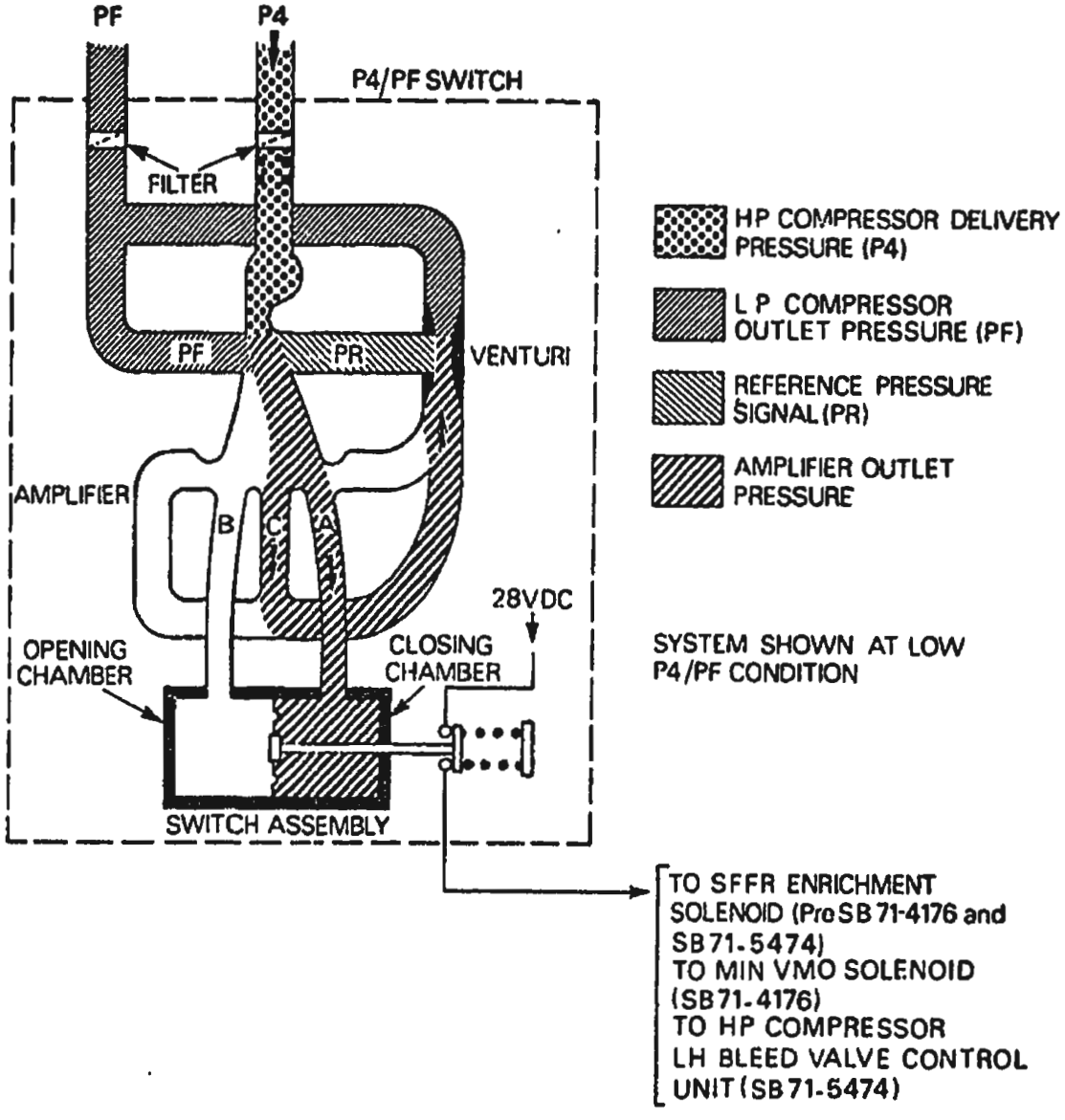
R Fuel control system diagrammatic layout
R (engines not incorporating S.B.73-4592)
R Fig.3 (Sheet 1)

R EFFECTIVITY: ALL



R Fuel control system diagrammatic layout
R (engines incorporating S.B.73-4592)
R Fig.3 (Sheet 2)

R EFFECTIVITY: ALL
R
050B 1S

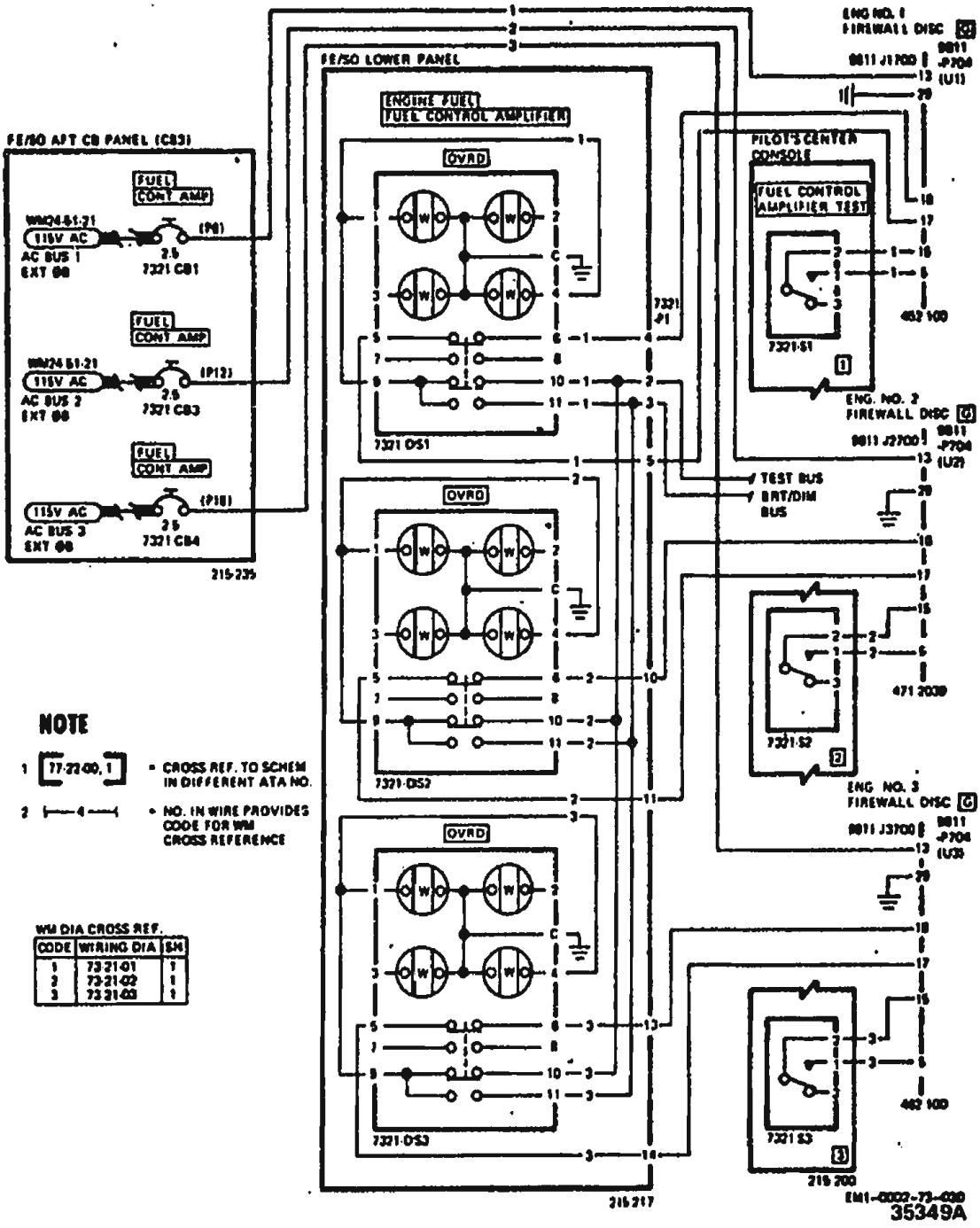


44740 A

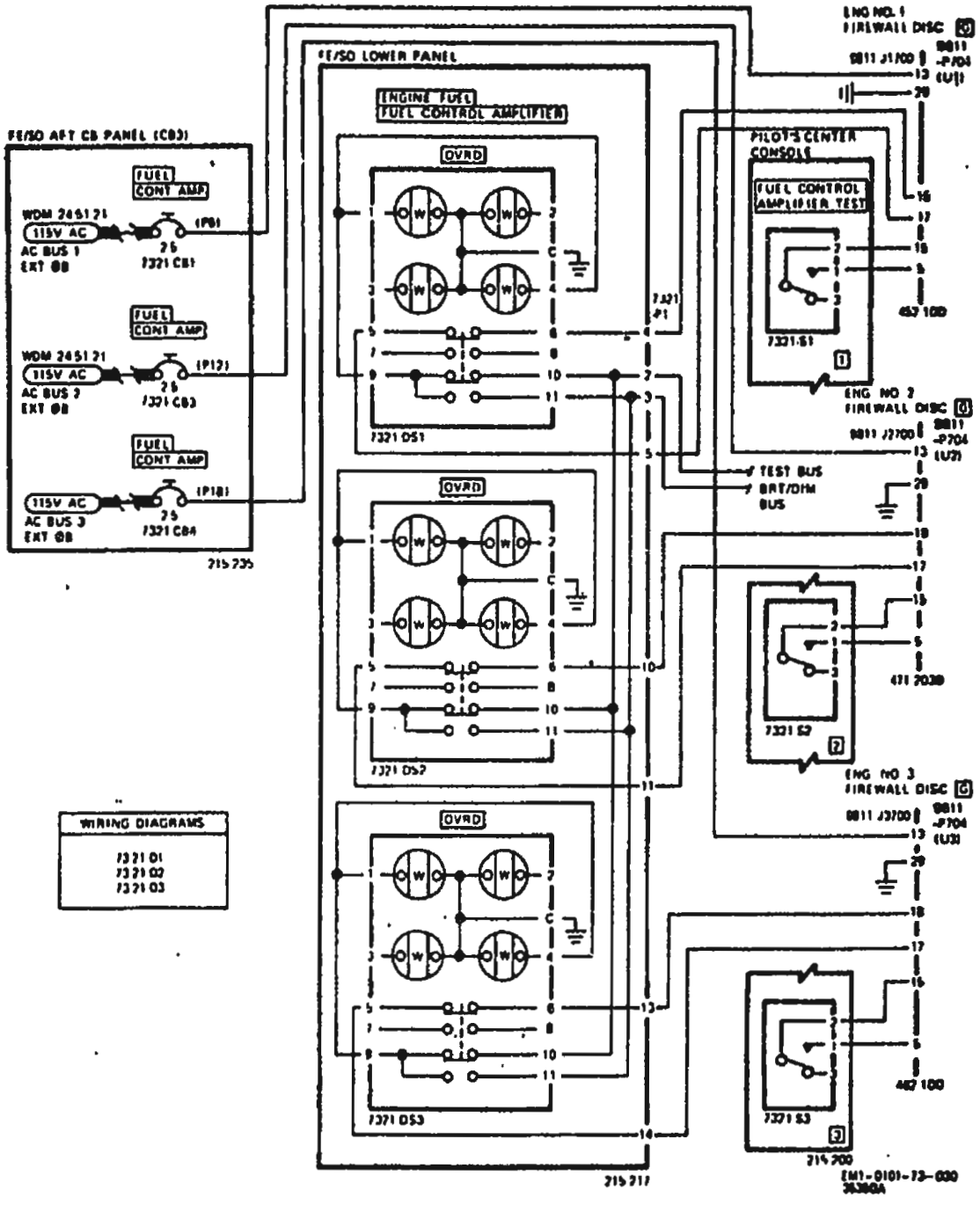
R P4/PF switch diagram
R Fig.4

R EFFECTIVITY: ALL

R
050B 1S



Fuel and control - Controlling (Aircraft No.1002-1028)
Fig.5 (Sheet 1)



Fuel and control - Controlling (Aircraft No.1029 and up)
Fig.5 (Sheet 2)

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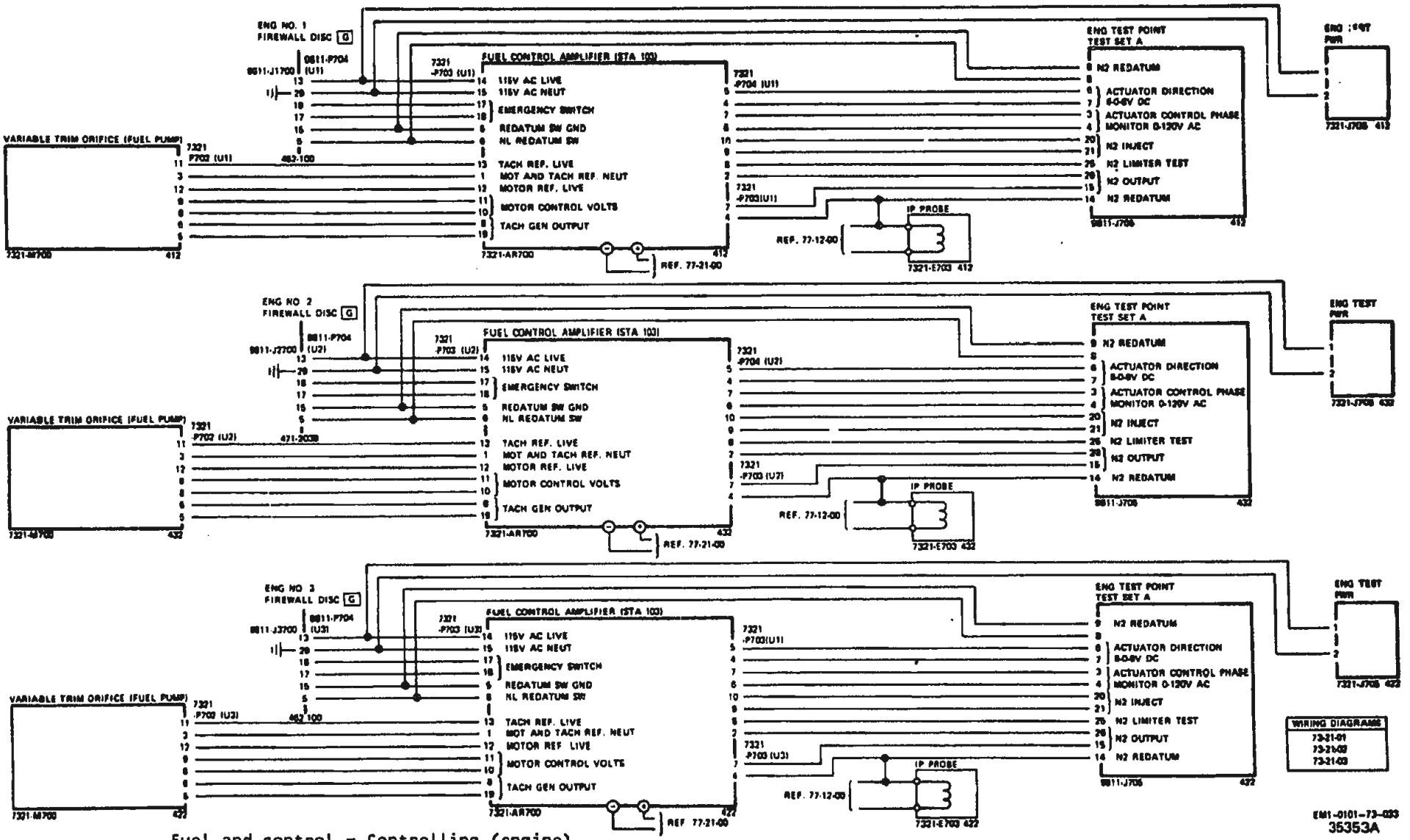
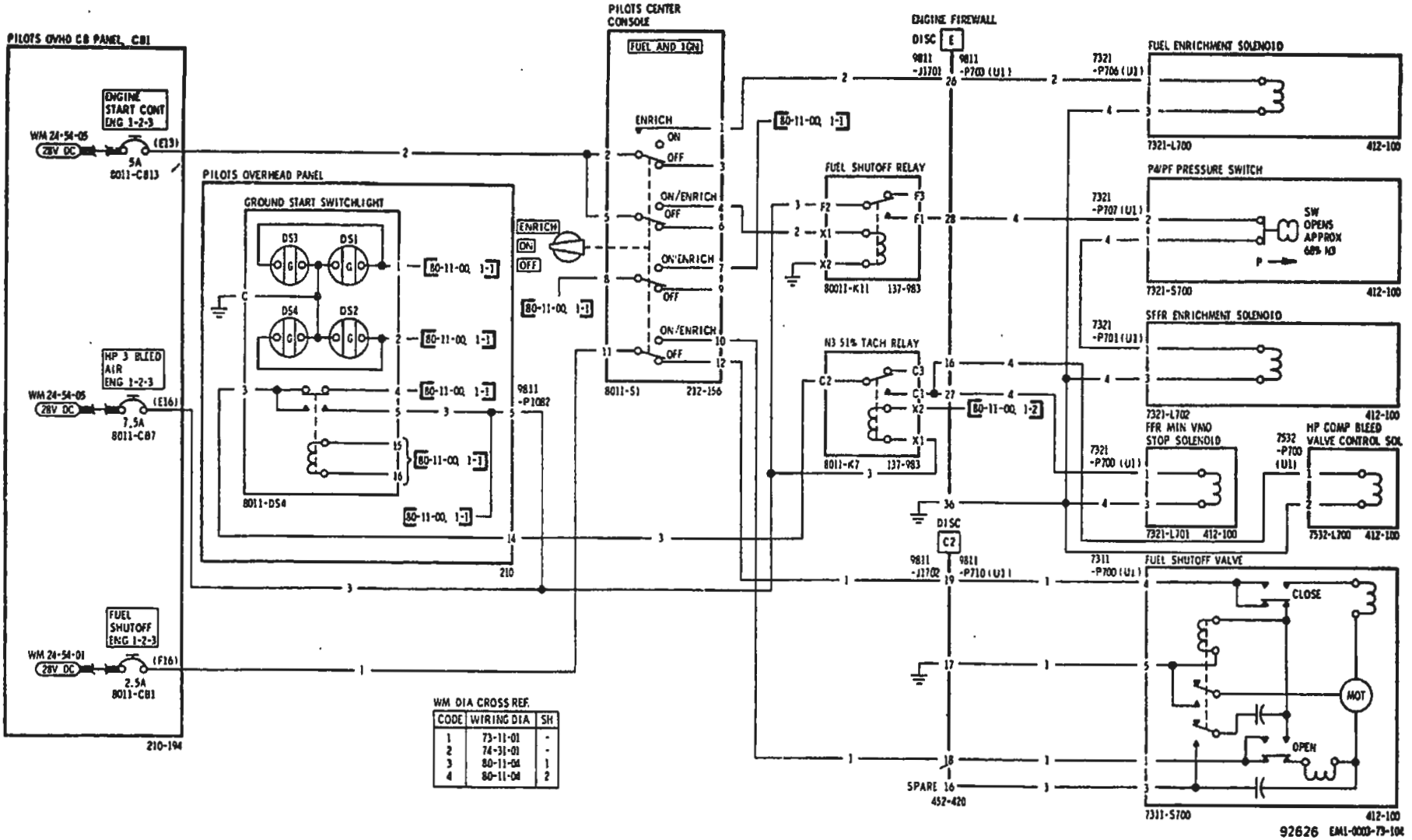
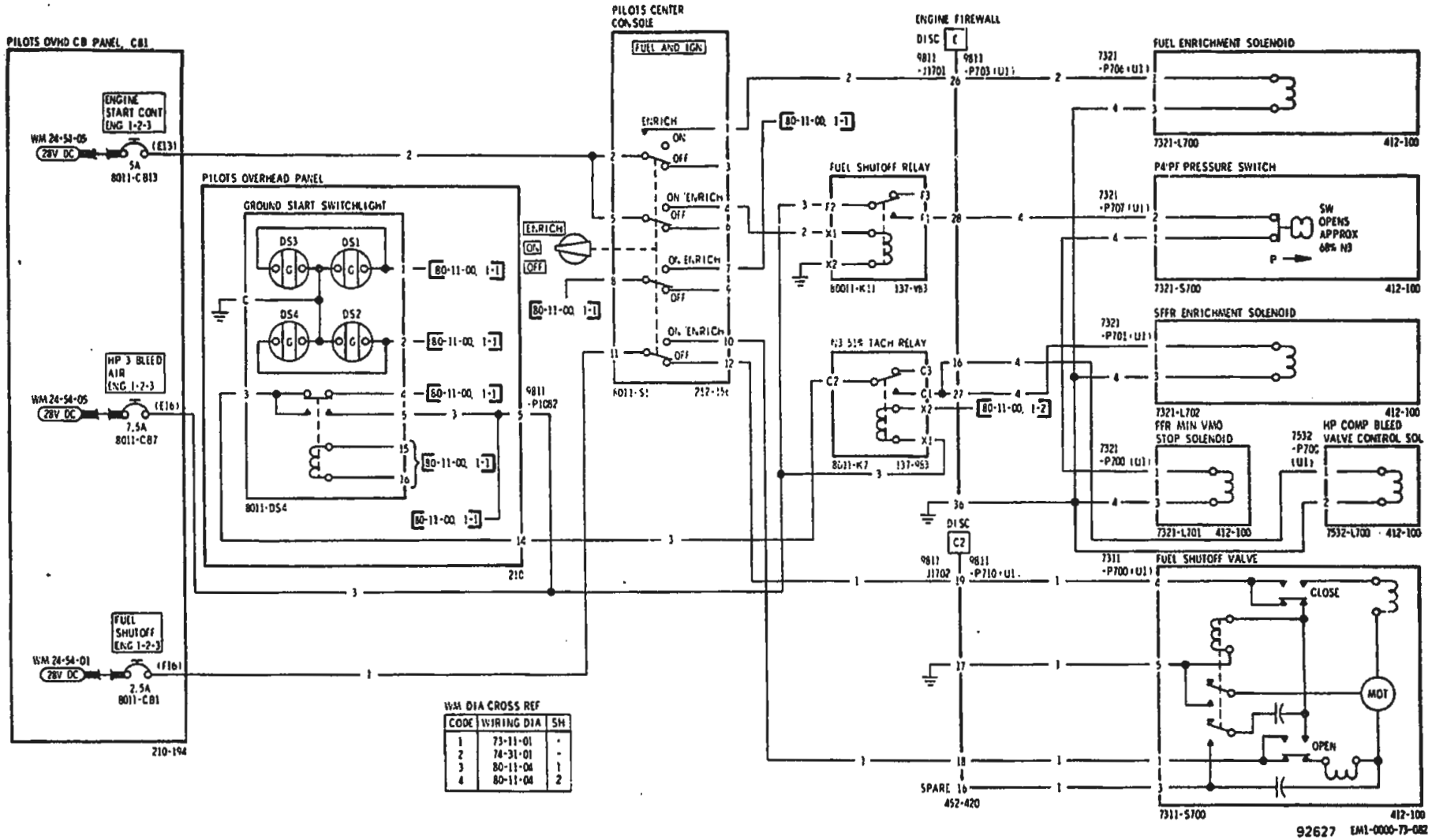


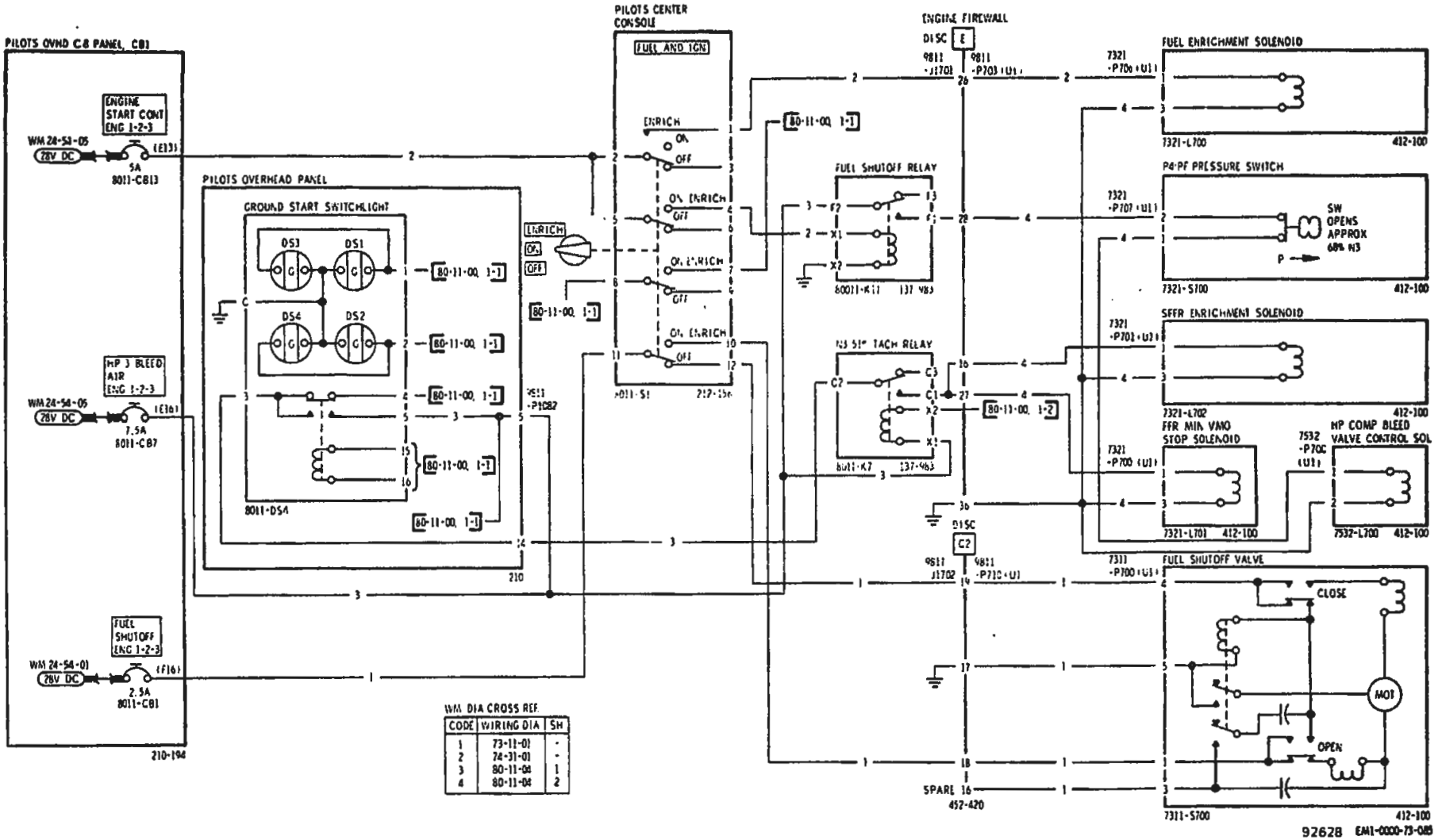
Fuel and control - Controlling (engine)
(Amplifier STA.103)
Fig.6 (Sheet 3)



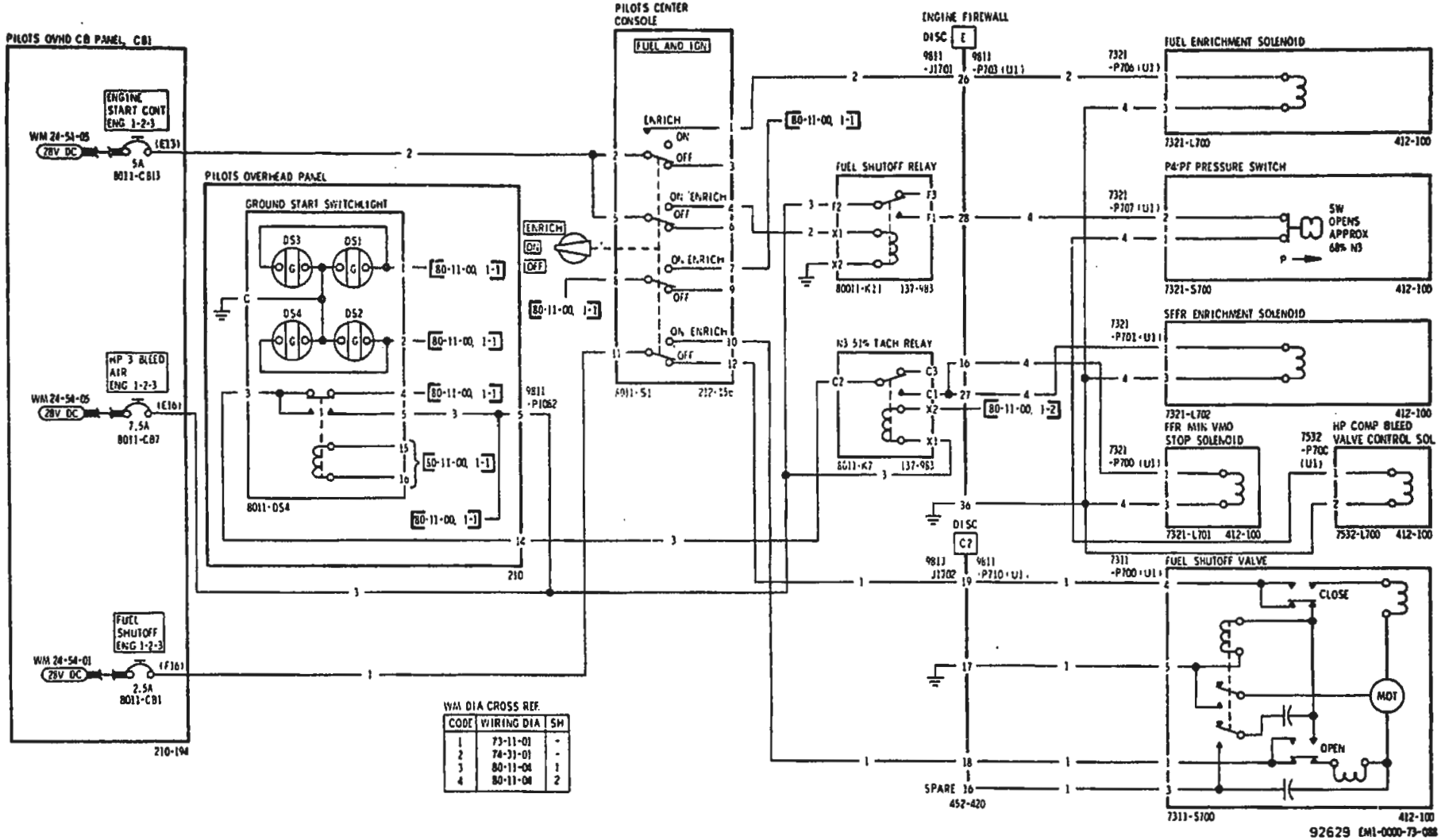
Engine control schematic - Engine No.1
Engines without S.B.71-4176 and S.B.71-5474
Fig.7 (Sheet 1)



Engine control schematic - Engine No.1
Engines with S.B.71-4176 without S.B.71-5474
Fig.7 (Sheet 2)



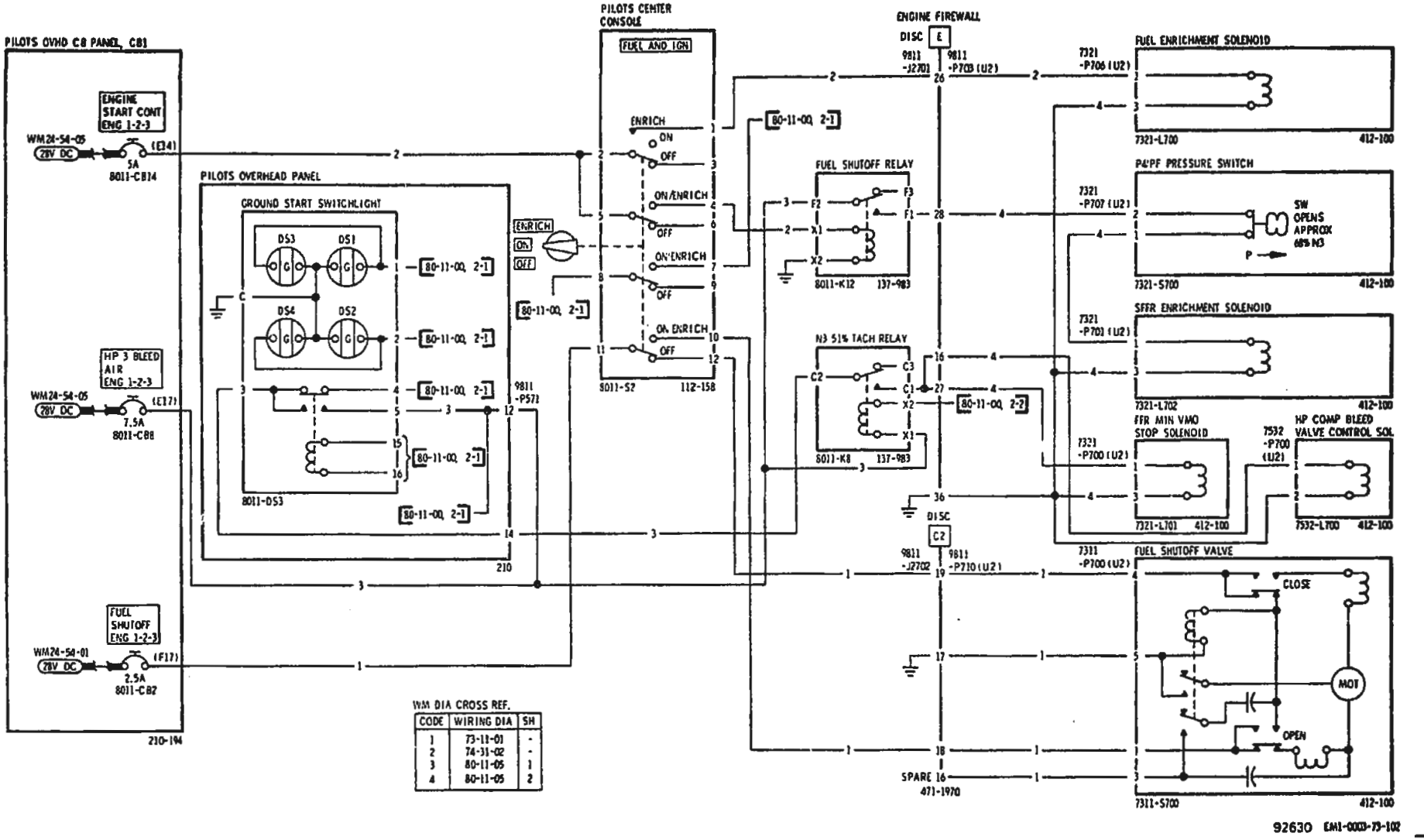
Engine control schematic - Engine No.1
Engines without S.B.71-4176 with S.B.71-5474
Fig.7 (Sheet 3)



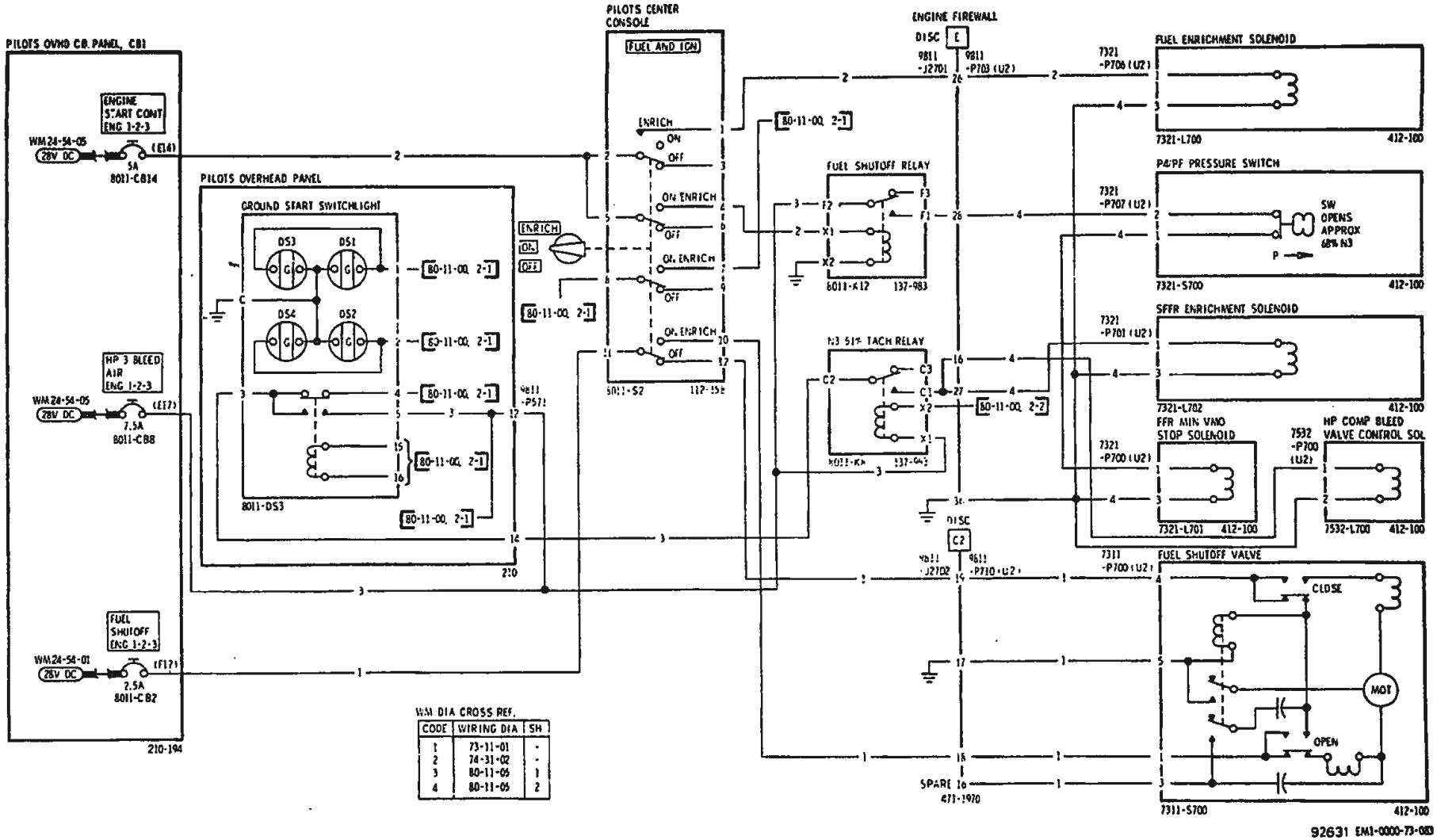
WM DIA CROSS REF.

CODE	WIRING DIA	SH
1	73-11-01	-
2	74-31-01	-
3	80-11-04	1
4	80-11-04	2

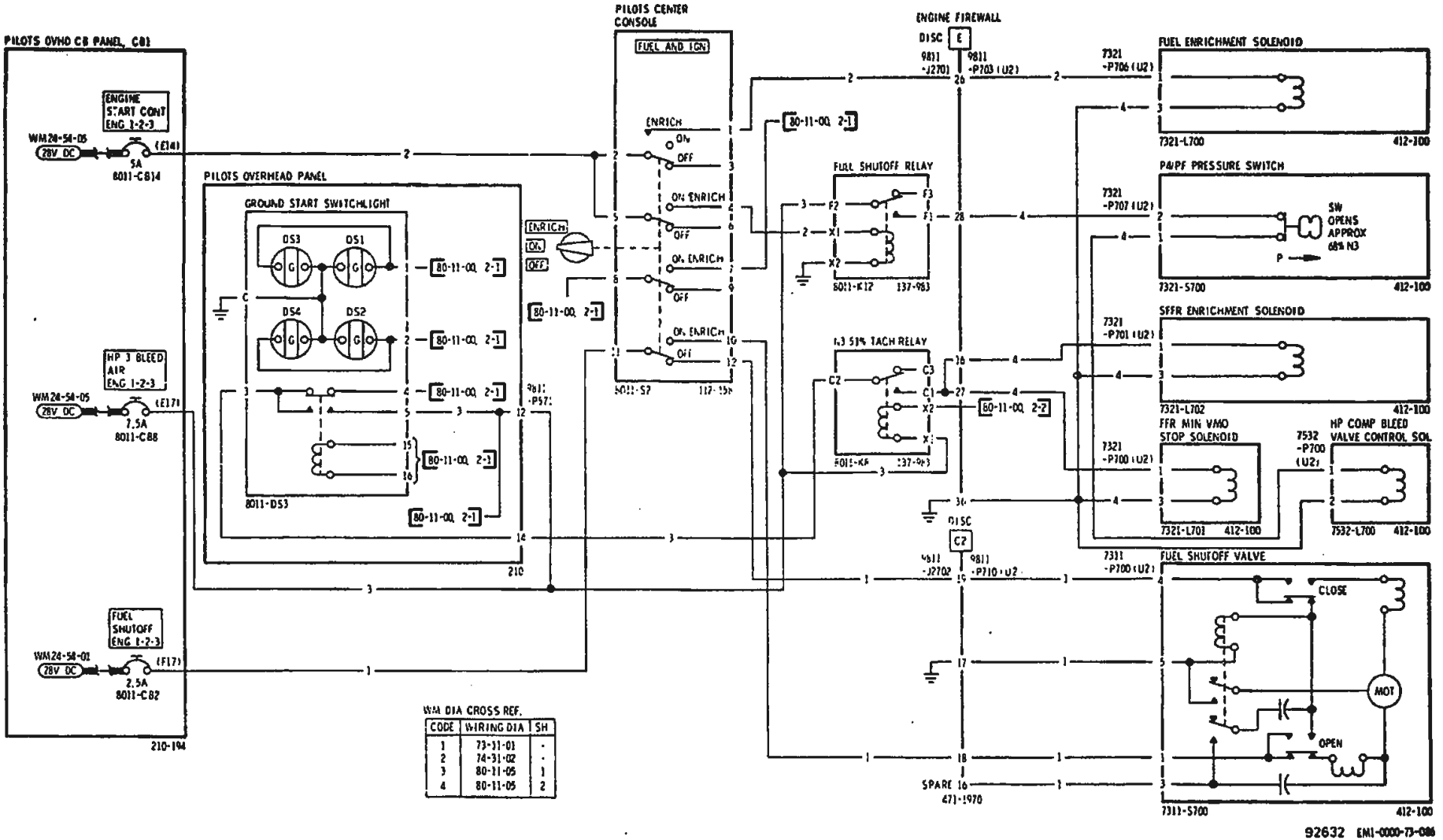
Engine control schematic - Engine No.1
Engines with S.B.71-4176 and S.B.71-5474
Fig.7 (Sheet 4)



Engine control schematic - Engine No.2
Engines without S.B.71-4176 and S.B.71-5474
Fig.7 (Sheet 5)



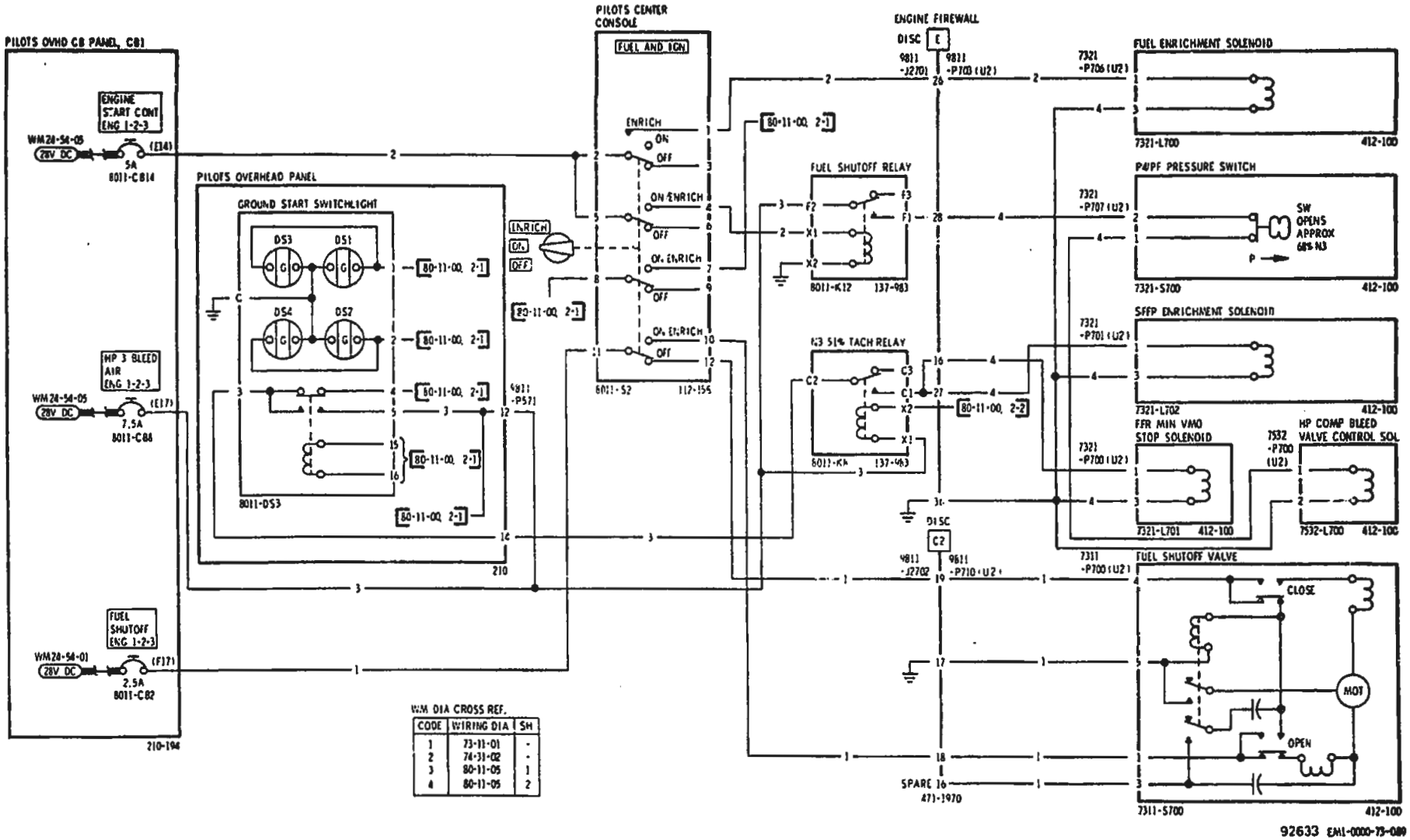
Engine control schematic - Engine No.2
Engines with S.B.71-4176 without S.B.71-5474
Fig.7 (Sheet 6)



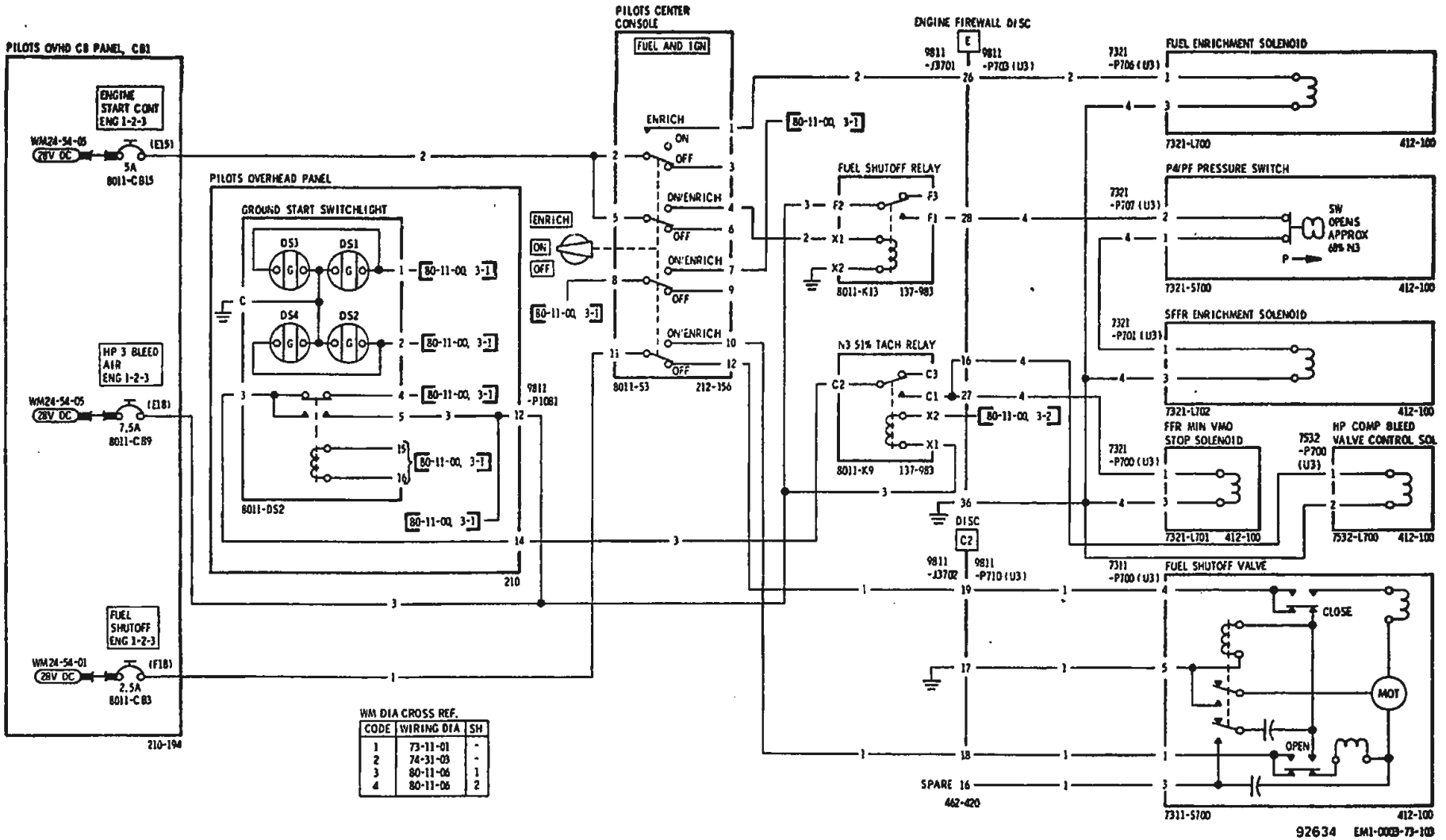
WM DIA CROSS REF.

CODE	WIRING DIA	SH
1	73-31-01	-
2	74-31-02	-
3	80-11-05	1
4	80-11-05	2

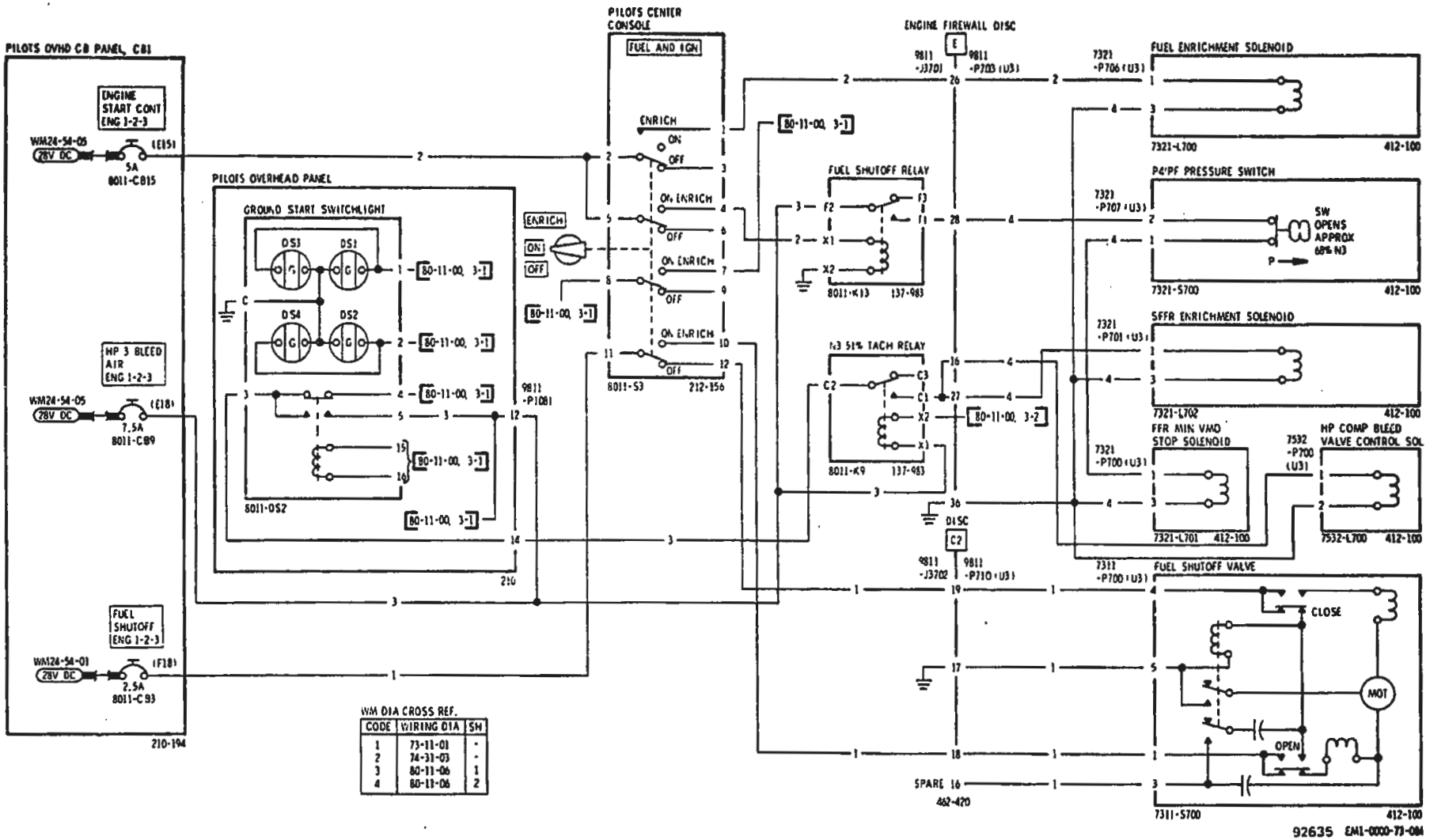
Engine control schematic - Engine No.2
Engines without S.B.71-4176 with S.B.71-5474
Fig.7 (Sheet 7)



Engine control schematic - Engine No.2
Engines with S.B.71-4176 and S.B.71-5474
Fig.7 (Sheet 8)



Engine control schematic - Engine No.3
Engines without S.B.71-4176 and S.B.71-5474
Fig.7 (Sheet 9)



WM DIA CROSS REF.

CODE	WIRING DIA	SH
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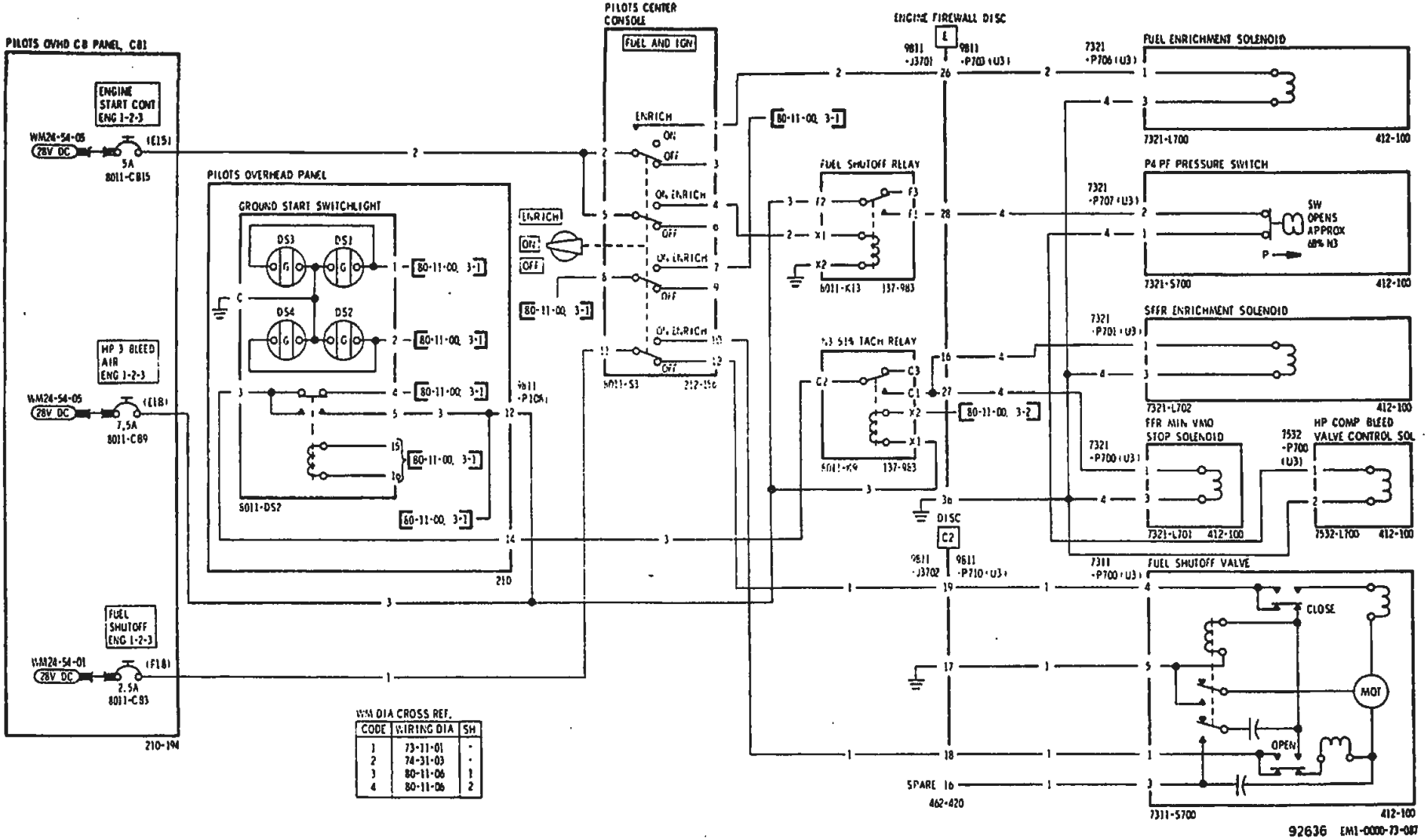
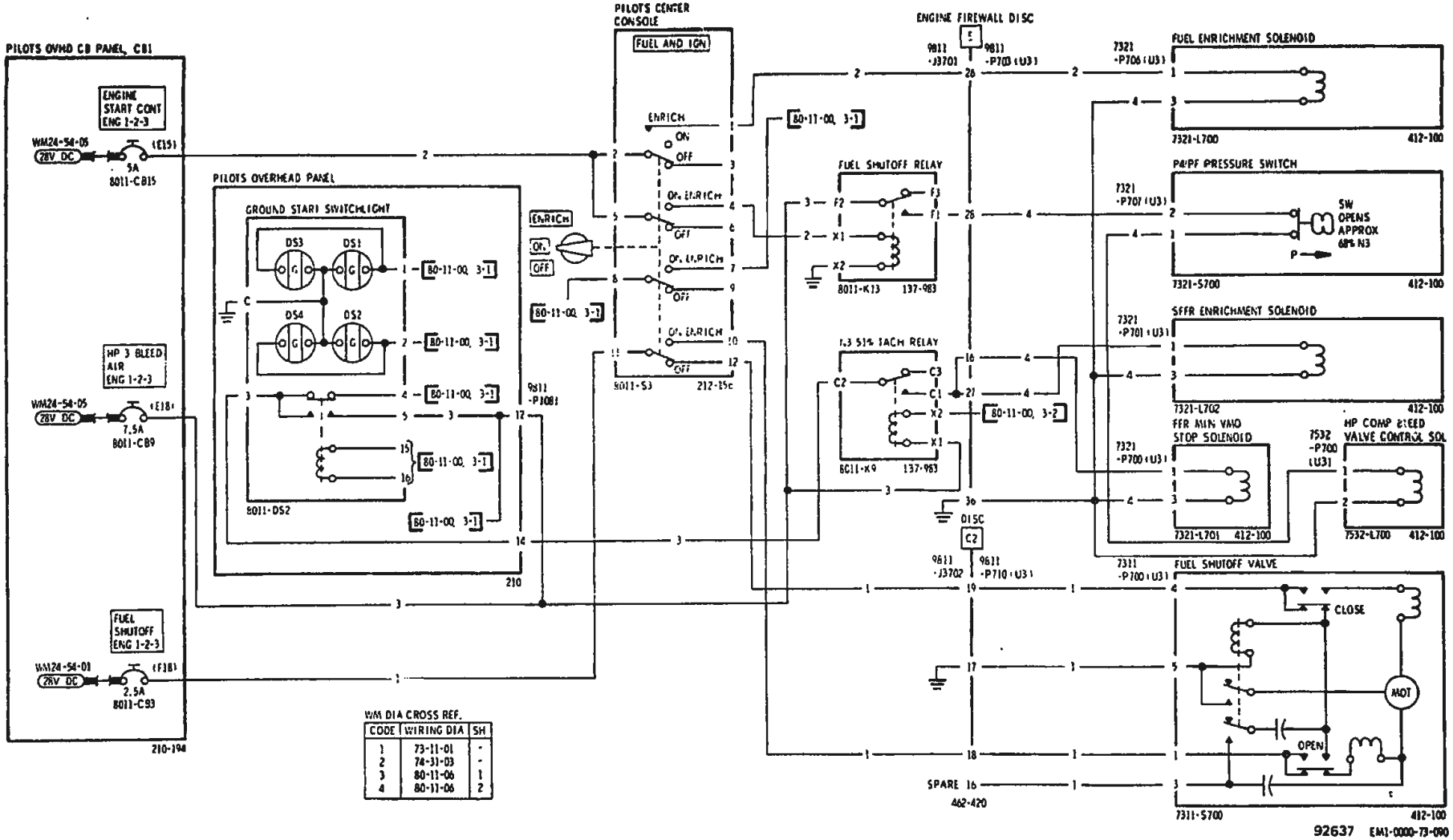
2	74-31-03	-
3	80-11-06	1
4	80-11-06	2

Engine control schematic - Engine No.3
Engines with S.B.71-4176 without S.B.71-5474
Fig.7 (Sheet 10)



Engine control schematic - Engine No.3
Engines without S.B.71-4176 with S.B.71-5474
Fig.7 (Sheet 11)



Engine control schematic - Engine No.3
Engines with S.B.71-4176 and S.B.71-5474
Fig.7 (Sheet 12)

ENGINE FUEL AND CONTROL - MAINTENANCE PRACTICES

1. Deactivate Fuel and Temperature Control Amplifier

The following procedure must only be effected as directed by the Minimum Equipment List (M.E.L.).

CR 2. Maintenance Procedures

CR A. General

CR This procedure verifies that the fuel control amplifier
CR control switch(es) is in the override position or the
CR alternate method of disconnecting the electrical connector on
CR the variable trim orifice (engine fuel pump assembly) is
CR performed.

CR B. Referenced Procedures

CR MM 6-50-00 Access Doors and Removable Panels

CR MM 24-41-00 External Power/Ground Services System -
CR Maintenance Procedures

CR 3. Procedures

CR A. Verification - Fuel and Temperature Control Amplifier In OVRD

CR (1) Apply external ground power, ref. MM 24-41-00.

CR (2) On the FE/SO panel, check that applicable OVRD
CR switchlight on, FUEL CONTROL AMPLIFIER panel is pressed
CR (latched) in and OVRD legend is on.

CR (3) Install placard on FE/SO FUEL CONTROL AMPLIFIER panel.

CR (4) Make appropriate entry in airplane log book.

CR (5) Remove electrical power is not required.

CR B. Alternate Procedure - Deactivate Fuel and Temperature Control
CR Amplifier

CR WARNING: THE VARIABLE TRIM ORIFICE WILL REMAIN IN ITS LAST
CR POSITION FOLLOWING REMOVAL OF THE ELECTRICAL
CR CONNECTOR. THIS COULD BE A TRIMMED POSITION AND
CR WOULD RESULT IN NOT OBTAINING FULL POWER.

CR NOTE: Alternate procedure should be used only when fuel
CR control amplifier has been determined to be at fault.

CR (1) Gain access to the affected low pressure/high pressure
CR fuel pump assembly through left hand hinged cowl 413A
CR (Engine 1), 433AL (Engine 2), 423A (Engine 3).

CR (2) Remove the electrical connector from the variable trim
CR orifice on the affected engine's fuel pump assembly.

CR (3) Install protective caps on the plug and receptacle.

CR (4) Stow the disconnected plug in a manner that will protect
CR the plug from damage.

CR (5) Close and secure the hinged cowling opened in Step (1).

CR (6) Install placard on FE/SO FUEL CONTROL AMPLIFIER panel.

CR (7) Make appropriate entry in airplane log book.

ENGINE FUEL CONTROL SYSTEM - ADJUSTMENT/TEST

1. General

CR A. New Technology RB211 Speed Control Amplifier (SCA 200)

CR (1) A new generation speed control amplifier (SCA 200) is
CR being introduced on an attrition basis.

CR (2) This new amplifier is both physically and electronically
CR interchangeable with our present STA 103 unit.
CR Functionally, the new unit differs from the STA 103 in
CR that the temperature T7 channel (TGT) is not monitored
CR or controlled. Thus the name SCA 200 (Speed Control
CR Amplifier 200). In view of this being an attrition type
CR changeout, it will be some time before the fleet is so
CR equipped with the new type SCA 200. In the interim,
CR both units will be maintained as described in the
CR Maintenance Manual. When it is necessary to change
CR either unit, engine operational checks remain the same
CR (Test 8). Refer to Engine Fuel Control System
CR Adjustment/Test for applicable test procedures using the
CR UT1000 test set. Test procedure with this test set
CR differs between amplifiers.

B. The Adjustment/Test procedures detailed in this section are described using Rolls-Royce UT1000/1 or 2 Test Set only. To locate the required Adjustment/Test procedure refer to the following table of paragraph references:

	Engine On-Wing	Engine Off-Wing
Test:	para.	para.
N2 Datum Setting	2.A.(5)	2.B.
N2 Overspeed Datum Setting	2.A.(6)	
T.G.T. (T7) Datum Setting	2.A.(7)	
N2 Redatum System	2.C.	
Redatum and Override System	2.D.	

EFFECTIVITY: Amplifier STA 103

Test:	Engine On-Wing para.	Engine Off-Wing para.
T.G.T. (T7) Starting Redatum	2.E.	

C. For Scheduled Maintenance Test of Speed and Temperature Governing System (Non-Mod S.B.73-3673) refer to paragraph 3.

D. For Adjustment of N2 Datum and T7 Datum Settings refer to paragraph 4.

E. For ease of reference, the illustrations referred to in text are grouped together at the end of this section.

2. Test Speed and Temperature Control Amplifier STA 103

CAUTION 1. IF DURING THE FOLLOWING AMPLIFIER TESTS, ANY OF THE CONDITIONS LISTED IN A. OR B. ARE ENCOUNTERED THEN FUEL PUMP TRIM ACTUATOR MOTOR RESISTANCE CHECK (REF.73-11-01, ADJUSTMENT/TEST) MUST BE PERFORMED PRIOR TO INSTALLATION OF A REPLACEMENT AMPLIFIER.

A. TEST SET MOTOR VOLTS GAUGE READING DOES NOT CHANGE WHEN 'INJECT' SIGNAL IS INCREASED.

B. TEST SET MOTOR VOLTS GAUGE READING CANNOT BE MAINTAINED AT A MINIMUM FOR 5 TO 10 SECONDS.

2. USE RECOMMENDED TEST PROCEDURES ONLY AS APPLICATION OF EXCESSIVE VOLTAGE WILL DAMAGE THE AMPLIFIER.

3. ENSURE ELECTRICAL CONNECTORS ARE FREE FROM LIQUID AND/OR SOLID CONTAMINATION BEFORE CONNECTING AND DISCONNECTING.

Service Bulletins referred to:

S.B.73-4916 - Speed and Temperature Control Amplifier N2 Speed Datum Increased from 102% to 104% N2

Referenced Procedures:

	24-41-00	External Power/Ground Service System
R	71-00-00	Power Plant - Adjustment/Test
	71-11-00	Cowlings, Engines No.1 and 3 - Servicing
	71-12-05	L.H. and R.H. Upper Hinged Cowl, Engine No.2 - Servicing
	73-11-01	Low Pressure Fuel Pump - Adjustment/Test
	73-21-02	Speed and Temperature Control Amplifier - Removal/Installation
	73-00-00	Fuel and Control - Fault Isolation

A. Functionally Test Amplifier STA 103 N2 and T.G.T. (T7) Datum Settings Using Test Set UT.1000/1 or UT.1000/2 (Engine On-Wing).

(1) Equipment required:

UT.1000/1	Test set
or	
UT.1000/2	Test set
UT.937/1	Lead
UT.997	Lead
UT.1124/1	Lead (Comprising UT.999/1 and UT.998)
U.999127	Carrying case

(2) Open L.H. hinged cowl 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433DL for engine No.2 (Ref. 71-12-05).

(3) Ensure amplifier test switch (zone 210) and amplifier override switch (zone 215) are set to normal (light out).

(4) Prepare for Testing

(a) Remove test set cover.

(b) Refer to fig.501, connect test set to engine test connectors as shown.

(c) Connect and energize external power system (24-41-00).

(d) Refer to fig.502, turn N INJECT knobpot fully anti-clockwise.

(e) Select test set power supply switch ON and check POWER indicator light comes on. Allow 2 minutes for test set to stabilize.

(5) Test N2 Datum Setting

(a) Set REDATUM switch to OFF (Centre position).

(b) Set N1/N2 INJECT switch to N2 and T7 INJECT switch to OFF.

(c) Set MEASURE N1/N2 switch to N2 and SPEED/TEMP switch to SPEED.

(d) Turn READSPEED control to achieve 90 (% N2) on digital display.

(e) Turn N INJECT knobpot clockwise until the lowest possible reading is obtained on MOTOR VOLTS gauge, then turn READSPEED control to centre zero GALVO and record digital display reading.

NOTE: If the lowest reading is overshot (i.e. the voltage commences to rise again) turn the N INJECT knobpot anti-clockwise one full turn then repeat operation.

(f) On amplifiers without S.B.73-4916, check the reading recorded in operation (e) is within the limits of 102.0 to 102.2%.

On amplifiers with S.B.73-4916, check reading recorded in operation (e) is within limits of 104.0 to 104.2% N2.

(g) If reading is not within limits adjust N2 datum setting (Ref. para.4.A.).

R R R (h) If the N2 maximum indicator warning light is illiminated press MAX IND RESET switch on Main Instrument/Glareshield Panel and ensure that N2 max. indicator pointer (on Flight Engineers Console - Engine Status Panel) returns to allowable N2 limit position and the warning light extinguishes.

(6) Test Amplifier Overspeed N2 Datum Setting

(a) Set REDATUM switch to SPEED SWITCH.

(b) Set N1/N2 INJECT switch to N2 and SPEED/TEMP switch to SPEED.

(c) Set T7 INJECT switch to OFF and MEASURE N1/N2 to N2.

(d) Turn READSPEED control to achieve 105 (% N2).

(e) Turn N INJECT knobpot to centre zero GALVO.

(f) Turn N INJECT knobpot slowly clockwise until a transient deflection of not less than 0.5 volts occurs on FEEDBACK TACHO VOLTS gauge.

NOTE: If a transient deflection of less than 0.5 volts is obtained perform Functional Test of L.P. Fuel Pump Variable Restrictor and Actuator and Trim Actuator Motor and Insulation Resistance check as detailed in 73-11-01 Adjustment/Test. If Fuel Pump Tests are satisfactory accept reading obtained.

(g) Turn READSPEED control to centre zero GALVO.

(h) On amplifiers without S.B.73-4916, check reading on digital display is within limit 106 to 108% N2. Record actual display reading.

On amplifiers with S.B.73-4916, check reading on digital display is within limits 108 to 110% N2. Record actual display reading.

(j) Continue to turn N INJECT knobpot one turn clockwise.

(k) Turn N INJECT knobpot slowly anti-clockwise until a transient deflection of approximately 0.1 volt occurs on FEEDBACK TACHO VOLTS gauge.

(m) Turn READSPEED control to centre zero GALVO.

(n) Check reading on digital display is within minus 1.0 % N2 of actual reading recorded in operation (h).

(p) If the criteria specified in this test is not met, reject fuel control amplifier.

R R R (q) If the maximum indicator warning light is illuminated press MAX IND RESET switch on Main Instrument/Glareshield Panel and ensure that N2 max. indicator pointer (on Flight Engineers Console - Engine Status Panel) returns to allowable N2 limit position and the warning light extinguishes.

(7) Test T.G.T. (T7) Datum Setting

(a) Refer to fig.501, disconnect lead UT.999/1 from test set and connect lead UT.997 as shown.

(b) Refer to fig.502, turn T7 INJECT knobpot fully anti-clockwise.

(c) Set REDATUM switch to OFF (Centre position).

(d) Set T7 INJECT switch to ON.

(e) Set N1/N2 INJECT switch to OFF (Centre position).

(f) Set SPEED/TEMP switch to TEMP.

(g) Set NORMAL/BALLASTED switch to BALLASTED.

(h) Turn temperature scale control to achieve a reading of 700 (deg.C.).

(j) Turn T7 INJECT knobpot clockwise until the lowest possible reading is obtained on MOTOR VOLTS gauge, then turn temperature scale slow motion drive to centre zero GALVO and record reading on temperature scale.

NOTE: If the lowest reading is overshot (i.e. if the voltage commences to rise again) turn the T7 INJECT knobpot, anti-clockwise one full turn then repeat operation.

(k) Check the reading recorded in operation (j) is within the limits of 748 to 751 deg.C.

(m) If reading is not within limits adjust T.G.T. datum setting (Ref. para.4.B.).

R (n) If the maximum indicator warning light is
R illuminated press MAX IND RESET switch on Main Instrument/Glareshield panel and ensure that max. indicator warning light on T.G.T. indicator is extinguished.

(8) Select test set power supply switch OFF.

(9) De-energize ground services system (Ref. 24-41-00).

(10) Disconnect test leads from engine and test set. Fit dust covers to all connectors and fit test set cover.

(11) Close L.H. hinged cowl 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433DL for engine No.2 (Ref. 71-12-05).

B. Functionally Test Amplifier STA 103 N2 and T.G.T. (T7) Datum Settings Using Test Set UT.1000/1 or UT.1000/2 (Engine Off-Wing)

(1) Equipment required:

UT.1000/1	Test set
or	
UT.1000/2	Test set
UT.937/1	Lead
UT.997	Lead
UT.1124/1	Lead (Comprising UT.999/1 and UT.998)
U.999127	Carrying case

(2) Identify pins 17 and 18 of plug 'G' (Engine/Pylon Interface) by commencing with centre pin of plug (pin No.1) and count in a clockwise direction following spiral white line on end face of insulator until pins 17 and 18 are reached. Fit shorting link (locally manufactured) to pins 17 and 18.

(3) Remove test set cover.

A 115 volts, 400 Hz A.C. supply is required to both engine and test set. To achieve this, use either two leads UT.937/1 with separate external power sources or a bifurcated lead of local manufacture.

(4) Refer to fig.501, connect lead UT.937/1 from power source to test set connector.

(5) Connect lead UT.937/1 from power source to engine test connector. If a bifurcated lead is used, connect lead from power source to test set connector and to engine test connector.

(6) Refer to fig.501, connect remaining leads as shown.

(7) Energize external power sources (Ref. 24-41-00).

(8) Refer to fig.502, select test set power supply switch ON and check POWER indicator light comes on. Allow 2 minutes for test set to stabilize.

(9) Proceed as detailed in operations 2.A.(5) through (10).

(10) Remove shorting link from pins 17 and 18 of plug 'G'.

C. Functionally Test Amplifier STA 103 N2 Redatum System Using Test Set UT.1000/1 or UT.1000/2 (Engine On-Wing)

(1) Equipment required:

UT.1000/1	Test set
or	
UT.1000/2	Test set
UT.937/1	Lead
UT.997	Lead
UT.1124/1	Lead (Comprising UT.999/1 and UT.998)
U.999127	Carrying case

(2) Open L.H. hinged cowl 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433DL for engine No.2 (Ref. 71-12-05).

(3) Ensure amplifier test switch (zone 210) and amplifier override switch (zone 215) are set to normal (light out).

(4) Prepare for testing as detailed in operation 2.A.(4).

(5) Test N2 datum setting as detailed in operation 2.A.(5).

(6) Refer to fig.502, set REDATUM switch to AMPLIFIER.

(7) Set N1/N2 INJECT switch to N2.

(8) Set MEASURE N1/N2 switch to N2.

(9) Set T7 INJECT switch to OFF.

(10) Turn N INJECT knobpot fully anti-clockwise.

(11) Turn READSPEED control to achieve 90 (% N2) on digital display.

(12) Turn N INJECT knobpot clockwise until lowest possible reading is obtained on MOTOR VOLTS gauge, then turn READSPEED control to centre zero GALVO and record digital display reading.

NOTE: If the lowest reading is overshot (i.e. if the voltage commences to rise again) turn the N INJECT knobpot anti-clockwise one full turn and repeat operation.

(13) Amplifiers without S.B.73-4916, check reading recorded in operation (12) is within the limits of 90.5 to 93.5%.

Amplifiers with S.B.73-4916, check reading recorded in operation (12) is within the limits of 92.5 to 95.5%.

R (14) If the criteria specified in this test is not met,
R reject fuel control amplifier.

(15) Select test set power supply switch OFF.

(16) De-energize ground services system (Ref. 24-41-00).

(17) Disconnect test leads from engine and test set. Fit dust covers to all connectors.

(18) Fit test set cover.

(19) Close L.H. hinged cowl 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433DL for engine No.2 (Ref. 71-12-05).

D. Functionally Test Amplifier Redatum and Override System Using Test Set UT.1000/1 or UT.1000/2 (Engine On-Wing).

CR This test can be used as an alternative to Test No.8, 71-00-00, Adjustment/Test on engines incorporating an STA 103 Amplifier providing an N2 redatum test has been effected on a test bed run prior to engine installation.

(1) Equipment required:

UT.1000/1	Test set
or	
UT.1000/2	Test set
UT.937/1	Lead
UT.1124/1	Lead (Comprising UT.999/1 and UT.998)
U.999127	Carrying case

(2) Open L.H. hinged cowl 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433DL for engine No.2 (Ref. 71-12-05).

(3) Ensure fuel control amplifier test switch (zone 210) and fuel control amplifier override switch (zone 215) are set to normal (light out).

(4) Remove test set cover.

(5) Refer to fig.501, connect test set to engine test connectors as shown.

(6) Connect and energize external power system (24-41-00).

(7) Refer to fig.502, select test set power supply switch ON and check POWER indicator light comes on. Allow 2 minutes for test set to stabilize.

(8) Set SPEED/TEMP switch to SPEED.

(9) Set N1/N2 INJECT switch to N2.

(10) Set T7 INJECT switch to OFF and REDATUM switch to OFF (Centre position).

(11) Set MEASURE N1/N2 switch to N2.

(12) Turn N INJECT knobpot fully anti-clockwise.

(13) Turn READSPEED control to achieve 101 (% N2) on digital display.

(14) Turn N INJECT knobpot clockwise to centre zero GALVO.

(15) Select fuel control amplifier OVRD switch (zone 215) to override position and check light comes on.

(16) While observing FEEDBACK TACHO VOLTS gauge, select fuel control amplifier test switch (zone 210) to reset position. Hold switch in position for 30 seconds and check no feedback voltage is indicated on gauge during this period.

(17) Still holding fuel control amplifier test switch in reset position, select OVRD switch to normal (light out) and check feedback voltage is indicated on FEEDBACK TACHO VOLTS gauge.

R (18) If the criteria specified in this test is not met,
R reject fuel control amplifier.

(19) Select fuel control amplifier test switch (zone 210) to normal position.

(20) Select test set power supply switch OFF.

(21) De-energize ground services system (Ref. 24-41-00).

(22) Refer to fig.501, disconnect test set leads from engine and test set. Fit dust covers to all connectors.

(23) Fit test set cover.

(24) Close L.H. hinged cowl 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433DL for engine No.2 (Ref. 71-12-05).

E. Functionally Test Amplifier STA 103 T.G.T. (T7) Starting Redatum Using Test Set UT.1000/1 or UT.1000/2 (Engine On-Wing).

CAUTION: ENSURE NO AIR PRESSURE IS APPLIED TO THE ENGINE START SYSTEM WHILE THIS TEST IS BEING EFFECTED.

(1) Equipment required:

UT.1000/1	Test set
or	
UT.1000/2	Test set
UT.937/1	Lead
UT.1124/1	Lead (Comprising UT.999/1 and UT.998)

(2) Ensure appropriate ENG ISLN VALVE switchlight on ENGINE BLEED CONTROL panel (zone 215) is released (out).

(3) Tag appropriate ENG ISLN VALVE switchlight.

(4) Open L.H. hinged cowl 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433DL for engine No.2 (Ref. 71-12-05).

(5) Ensure amplifier test switch (zone 210) and amplifier override switch (zone 215) are set to normal (light out).

(6) Prepare for testing

(a) Remove test set cover.

(b) Refer to fig.501, connect test set to engine test connectors as shown.

(c) Connect and energize external power system (24-41-00).

(d) Refer to fig.502, turn T7 INJECT knobpot fully anti-clockwise.

(e) Select test set power supply switch ON and check POWER indicator light comes on. Allow 2 minutes for test set to stabilize.

(7) Set T7 INJECT switch to ON.

(8) Set SPEED/TEMP switch to TEMP.

(9) Set NORMAL/BALLASTED switch to NORMAL.

(10) Turn temperature scale control to achieve a reading of between 450 to 500 (deg.C.).

(11) Turn T7 INJECT knobpot clockwise to centre zero GALVO.

(12) Press GROUND START switchlight on pilot's overhead GROUND START panel (zone 210) and check for deflection of voltage on FEEDBACK TACHO VOLTS gauge.

(13) Press GND START RELEASE switchlight on pilot's overhead GROUND START panel (zone 210) and check for deflection of voltage on MOTOR VOLTS gauge.

(14) If the criteria specified in this test is not met, reject fuel control amplifier.

(15) Select test set power supply switch OFF.

(16) De-energize ground services system (Ref. 24-41-00).

(17) Remove tag from appropriate ENG ISLN VALVE switchlight.

(18) Disconnect test leads from engine and test set. Fit dust covers to all connectors.

(19) Fit test set cover.

(20) Close L.H. hinged cowl 413A or 423A for engine No.1 and 3 (Ref. 71-11-00) or 433DL for engine No.2 (Ref. 71-12-05).

3. Scheduled Maintenance Test of Speed and Temperature Governing System (Non-Mod S.B.73-3673) - Rolls-Royce Test Set

This test must only be effected as directed by Non-Mod. S.B.73-3673.

R NOTE: If test set is not available TEST No.9 - Speed and
R temperature control amplifier redatum test (Ref. 71-00-00)
R can be performed as an alternative.

A. Equipment Required.

UT1000/1	Test set
or	
UT1000/2	Test set
UT937/1	Lead
UT997	Lead
UT1124/1	Lead (Comprising lead UT998 and lead UT999/1)
U999127	Carrying case

B. Engine On-Wing - Preparation

(1) Open L.H. hinged cowl 413A or 423A for engine No.1 or 3 (Ref.71-11-00) or 433DL for engine No.2 (Ref.71-12-05).

(2) Ensure amplifier test switch (Zone 210) and override switch (Zone 215) are set to normal.

(3) Refer to fig.501, connect UT1124/1 and UT937/1.

(4) Energize ground services system (Ref. 24-41-00).

(5) Refer to fig.502, turn N INJECT knobpot fully anti-clockwise.

(6) Select power switch to ON and allow 2 minutes for set to stabilize.

C. Engine Off-Wing - Preparation

(1) Identify pins 17 and 18 of Engine/Pylon Interface plug 'G' 9811-P704 and fit locally manufactured shorting link to them.

NOTE: Pin number 1 is centre pin. Count pins clockwise following white spiral line.

(2) Remove test set cover.

A 115 volts, 400 Hz A.C. supply is required to both engine and test set. To achieve this, use either two leads UT937/1 with separate external power sources or a bifurcated lead of local manufacture.

(3) Refer to fig.501 and connect lead UT937/1 from power source to test set connector.

(4) Connect lead UT937/1 from power source to engine test connector. If a bifurcated lead is used, connect lead from power source to test set connector and to engine test connector.

(5) Refer to fig.501, connect leads UT998 and UT999/1.

(6) Turn N INJECT and T7 INJECT knobpots fully anti-clockwise.

(7) Energize ground services system (Ref. 24-41-00).

(8) Refer to fig.502, select POWER switch to ON and check POWER indicator light comes on. Allow 2 minutes for set to stabilize.

D. Test Procedure

For identification of switches and gauges in this procedure, refer to fig.502.

(1) Set REDATUM switch to SPEEDSWITCH.

(2) Set T7 INJECT switch to OFF.

(3) Set GALVO switch to SPEED.

(4) Set N1/N2 INJECT switch to OFF.

(5) Turn N INJECT knobpot fully clockwise.

(6) Set N1/N2 INJECT switch to N2 and check for large deflection (full scale) on FEEDBACK TACHO VOLTS gauge and subsequent return to zero of the gauge needle.

(7) Set N1/N2 INJECT switch to OFF and check for small deflection, in opposite direction to that observed in (6), on FEEDBACK TACHO VOLTS gauge and subsequent return to zero of the gauge needle.

(8) Turn N INJECT knobpot fully anti-clockwise.

(9) Set REDATUM switch to OFF.

(10) Refer to fig.501, disconnect lead UT999/1, leg of UT1124/1, and connect UT997 as shown.

(11) Set GALVO switch to TEMP.

(12) Ensure T7 and N1/N2 switches selected OFF.

(13) Turn T7 INJECT knobpot fully clockwise.

(14) Select T7 INJECT switch ON and observe large deflection of more than 0.5 volts on the FEEDBACK TACHO VOLTS gauge and subsequent return to zero of gauge needle.

(15) Select T7 INJECT switch to OFF and observe small deflection in opposite direction to that observed in (14) on FEEDBACK TACHO VOLTS gauge, and subsequent return to zero of gauge needle.

(16) If the criteria specified in this test is not met, refer to 73-00-00, Fuel and Control - Fault Isolation.

R

E. Turn T7 INJECT knobpot fully anti-clockwise.

F. Refer to fig.501, select POWER switch to OFF.

G. De-energize ground services system (Ref, 24-41-00).

H. Disconnect and remove test leads; fit dust covers to all connectors.

J. On non-installed engines; remove shorting link from Engine/ Pylon interface plug G.

R K. On installed engines; close L.H. hinged cowl 413A or 423A for
R engine No.1 and 3 (Ref.71-11-00) or 433DL for engine No.2
R (Ref.71-12-05).

4. Adjust Speed and Temperature Control Amplifier STA 103

A. Adjust N2 Datum Setting

(1) Equipment required:

T.496300 Adjusting key

R (2) Refer to Fig.503, using key T.496300, turn adjuster clockwise to increase datum setting or anti-clockwise to decrease datum setting. One turn of adjuster alters N2 speed approximately 0.7 per cent.

NOTE: The adjuster is only lightly loaded and care should be taken when making adjustment.

(3) Functionally re-test amplifier N2 datum setting (Ref. para.2.A.(5)).

B. Adjust T.G.T. (T7) Datum Setting

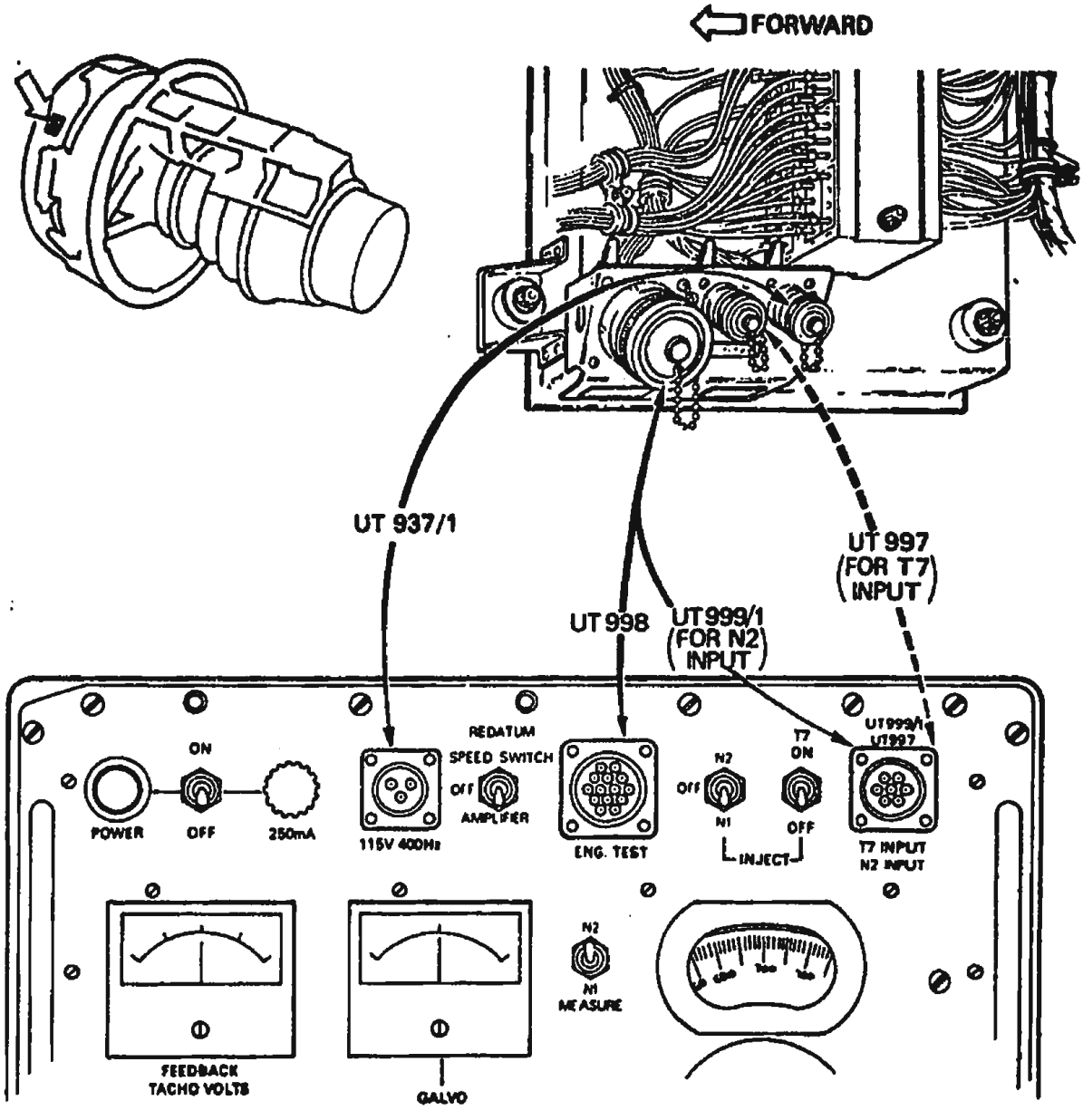
(1) Equipment required:

T.496300 Adjusting key

R (2) Refer to Fig.503, using key T.496300, turn adjuster clockwise to increase datum setting or anti-clockwise to decrease datum setting. One turn of adjuster alters temperature by approximately 5 deg.C.

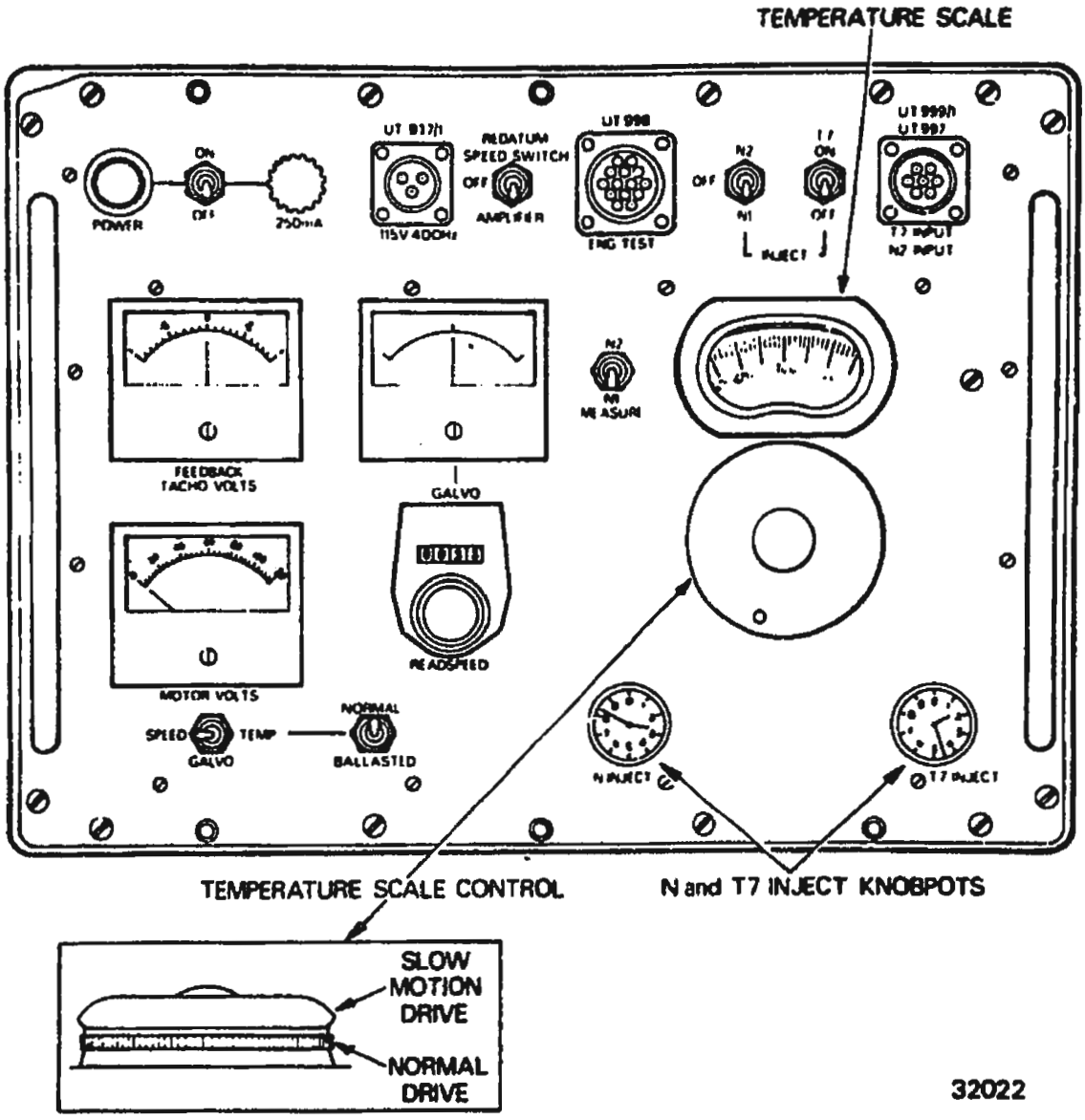
NOTE: The adjuster is only lightly loaded and care should be taken when making adjustment.

(3) Functionally re-test amplifier T7 datum setting (Ref. para.2.A.(7)).

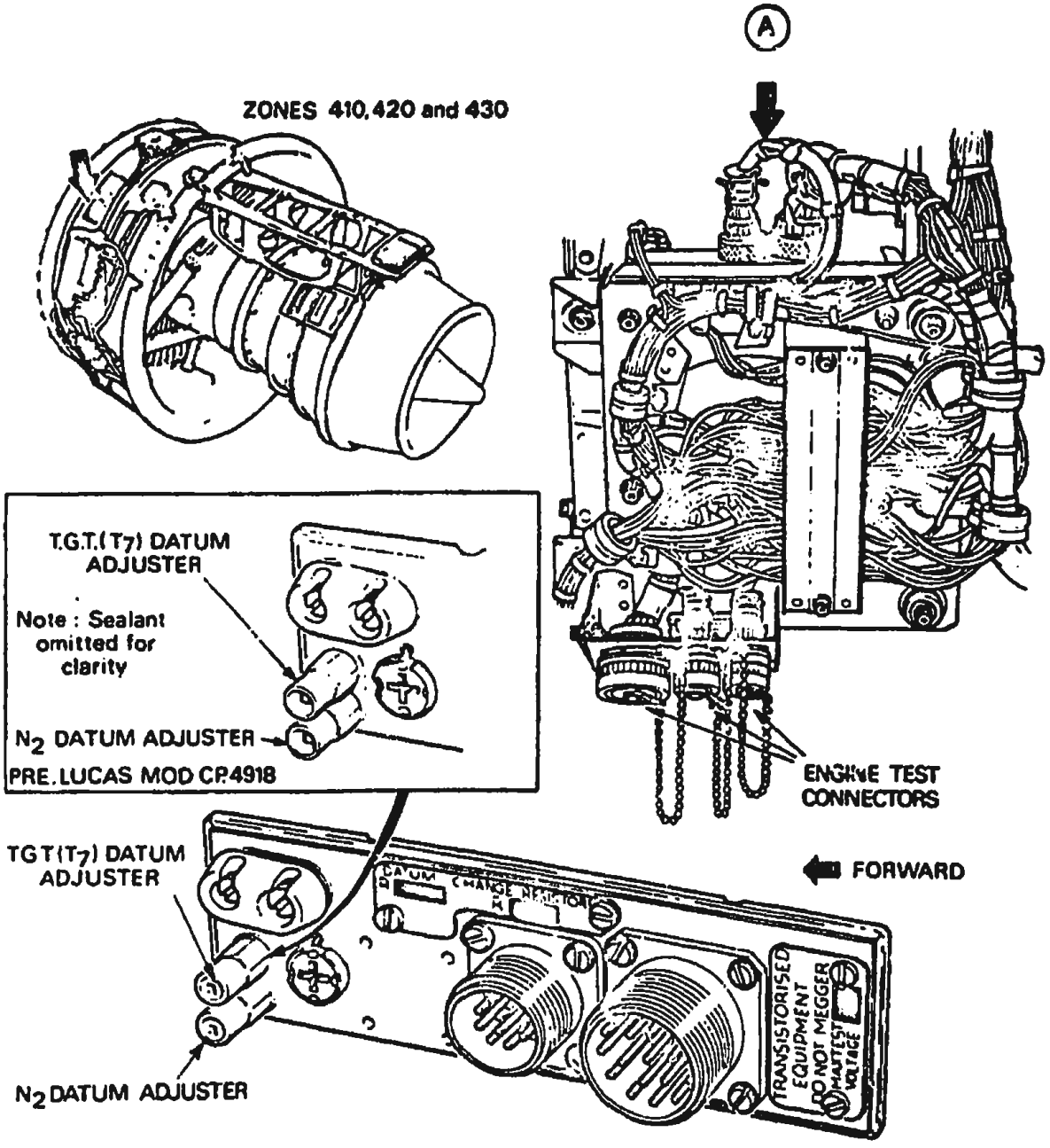


Test set UT.1000/1 or UT.1000/2 to engine, test lead connections
Fig.501

EFFECTIVITY: Amplifier STA 103



Test set UT.1000/1 or UT.1000/2 front panel
Fig.502



VIEW ON A (AMPLIFIER FRONT FACE) CONNECTORS AND HARNESSES OMITTED FOR CLARITY

31515A

Amplifier STA 103 adjustment
Fig.503

EFFECTIVITY: Amplifier STA 103

ENGINE FUEL CONTROL SYSTEM - ADJUSTMENT/TEST

1. General

CR A. New technology RB211 speed control amplifier (SCA 200)

CR (1) A new generation speed control amplifier (SCA 200) is
CR being introduced on an attrition basis (Figure 1).

CR (2) This new amplifier is both physically and electronically
CR interchangeable with our present STA 103 unit.
CR Functionally, the new unit differs from the STA 103 in
CR that the temperature T7 channel (TGT) is not monitored
CR or controlled. Thus the name SCA 200 (Speed Control
CR Amplifier 200). In view of this being an attrition type
CR changeout, it will be some time before the fleet is so
CR equipped with the new type SCA 200. In the interim, both
CR units will be maintained as described in the Maintenance
CR Manual. When it is necessary to change either unit,
CR engine operational checks remain the same (Test 8).
CR Refer to Engine Fuel Control System Adjustment/Test for
CR applicable test procedures using the UT1000 test set.
CR Test procedure with this test set differs between
CR amplifiers.

B. The Adjustment/Test procedures detailed in this section are described using Rolls-Royce UT1000/1 or 2 Test Set only. To locate the required Adjustment/Test procedure refer to the following table of paragraph references:

	Engine On-Wing	Engine Off-Wing
Test:	para.	para.
N2 Datum Setting	2.A.(5)	2.B.
N2 Overspeed Datum Setting	2.A.(6)	
N2 Redatum System	2.C.	
Redatum and Override System	2.D.	
Starting Trim	2.E.	

EFFECTIVITY: Amplifier SCA 200

C. For Scheduled Maintenance Test of Speed Governing System (Non-Mod S.B.73-3673) refer to paragraph 3.

D. For Adjustment of N2 Datum Setting refer to paragraph 4.

E. For ease of reference, the illustrations referred to in the text are grouped together at the end of this section.

2. Test Speed Control Amplifier SCA 200

CAUTION 1. IF DURING THE FOLLOWING AMPLIFIER TESTS, ANY OF THE CONDITIONS LISTED IN A. OR B. ARE ENCOUNTERED THEN FUEL PUMP TRIM ACTUATOR MOTOR RESISTANCE CHECK (REF.73-11-01, ADJUSTMENT/TEST) MUST BE PERFORMED PRIOR TO INSTALLATION OF A REPLACEMENT AMPLIFIER.

A. TEST SET MOTOR VOLTS GAUGE READING DOES NOT CHANGE WHEN 'INJECT' SIGNAL IS INCREASED.

B. TEST SET MOTOR VOLTS GAUGE READING CANNOT BE MAINTAINED AT A MINIMUM FOR DURATION OF TRIM MOTOR OPERATION.

2. USE RECOMMENDED TEST PROCEDURES ONLY AS APPLICATION OF EXCESSIVE VOLTAGE WILL DAMAGE THE AMPLIFIER.

3. ENSURE ELECTRICAL CONNECTORS ARE FREE FROM LIQUID AND/OR SOLID CONTAMINATION BEFORE CONNECTING AND DISCONNECTING.

Referenced Procedures:

	24-41-00	External Power/Ground Service System
R	71-00-00	Power Plant - Adjustment/Test
	71-11-00	Cowlings, Engines No.1 and 3 - Servicing
	71-12-05	L.H. and R.H. Upper Hinged Cowl, Engine No.2 - Servicing
	73-11-01	Low Pressure Fuel Pump - Adjustment/Test
	73-21-02	Speed Control Amplifier - Removal/Installation
	73-00-00	Fuel and Control - Fault Isolation

A. Functionally Test Amplifier SCA 200 N2 Datum Setting Using Test Set UT.1000/1 or UT.1000/2 (Engine On-Wing).

(1) Equipment required:

UT.1000/1	Test set
or	
UT.1000/2	Test set
UT.937/1	Lead
UT.1124/1	Lead (Comprising UT.999/1 and UT.998)
U.999127	Carrying case

(2) Open L.H. hinged cowl 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433DL for engine No.2 (Ref. 71-12-05).

(3) Ensure amplifier test switch (zone 210) and amplifier override switch (zone 215) are set to normal (light out).

(4) Prepare for Testing

(a) Remove test set cover.

(b) Refer to fig.501, connect test set to engine test connectors as shown.

(c) Connect and energize external power system (24-41-00).

(d) Refer to fig.502, turn N INJECT knobpot fully anti-clockwise.

(e) Select test set power supply switch ON and check POWER indicator light comes on. Allow 2 minutes for test set to stabilize.

(5) Test N2 Datum Setting

(a) Set REDATUM switch to OFF (Centre position).

(b) Set N1/N2 INJECT switch to N2 and T7 INJECT switch to OFF.

(c) Set MEASURE N1/N2 switch to N2 and SPEED/TEMP switch to SPEED.

R (d) Turn READSPEED control to achieve 84 (% N2) on digital display.

(e) Turn N INJECT knobpot clockwise until the lowest possible reading is obtained on MOTOR VOLTS gauge, then turn READSPEED control to centre zero GALVO and record digital display reading.

NOTE: If the lowest reading is overshot (i.e. the voltage commences to rise again) turn the N INJECT knobpot anti-clockwise one full turn then repeat operation.

(f) Check the reading recorded in operation (e) is within the limits 102.0 to 102.2%.

(g) If reading is not within limits adjust N2 datum setting (Ref. para.4.A.).

R (h) If the N2 maximum indicator warning light is
R illuminated press MAX IND RESET switch on Main
R Instrument/Glareshield Panel and ensure that N2 max. indicator pointer (on Flight Engineers Console - Engine Status Panel) returns to allowable N2
R limit position and the warning light extinguishes.

(6) Test Amplifier Overspeed N2 Datum Setting

(a) Set REDATUM switch to SPEED SWITCH.

(b) Set N1/N2 INJECT switch to N2 and SPEED/TEMP switch to SPEED.

(c) Set T7 INJECT switch to OFF and MEASURE N1/N2 to N2.

(d) Turn READSPEED control to achieve 105 (% N2).

(e) Turn N INJECT knobpot to centre zero GALVO.

(f) Turn N INJECT knobpot slowly clockwise until a transient deflection of not less than 0.5 volts occurs on FEEDBACK TACHO VOLTS gauge.

NOTE: If a transient deflection of less than 0.5 volts is obtained perform Functional Test of L.P. Fuel Pump Variable Restrictor and Actuator and Trim Actuator Motor and Insulation Resistance check as detailed in 73-11-01 Adjustment/Test. If Fuel Pump Tests are satisfactory accept reading obtained.

(g) Turn READSPEED control to centre zero GALVO.

(h) Check reading on digital display is within limit 106 to 108% N2. Record actual display reading.

(j) Continue to turn N INJECT knobpot one turn clockwise.

(k) Turn N INJECT knobpot slowly anti-clockwise until a transient deflection of approximately 0.1 volt occurs on FEEDBACK TACHO VOLTS gauge.

(m) Turn READSPEED control to centre zero GALVO.

(n) Check reading on digital display is within minus 1.0 % N2 of actual reading recorded in operation (h).

(p) If the criteria specified in this test is not met, reject fuel control amplifier.

R (q) If the maximum indicator warning light is
R illuminated press MAX IND RESET switch on Main
R Instrument/Glareshield Panel and ensure that N2 max. indicator pointer (on Flight Engineers Console - Engine Status Panel) returns to allowable N2 limit
R position and the warning light extinguishes.

B. Functionally Test Amplifier SCA 200 N2 Datum Setting Using Test Set UT.1000/1 or UT.1000/2 (Engine Off-Wing)

(1) Equipment required:

UT.1000/1	Test set
or	
UT.1000/2	Test set
UT.937/1	Lead
UT.1124/1	Lead (Comprising UT.999/1 and UT.998)
U.999127	Carrying case

(2) Identify pins 17 and 18 of plug 'G' (Engine/Pylon Interface) by commencing with centre pin of plug (pin No.1) and count in a clockwise direction following spiral white line on end face of insulator until pins 17 and 18 are reached. Fit shorting link (locally manufactured) to pins 17 and 18.

(3) Remove test set cover.

A 115 volts, 400 Hz A.C. supply is required to both engine and test set. To achieve this, use either two leads UT.937/1 with separate external power sources or a bifurcated lead of local manufacture.

(4) Refer to fig.501, connect lead UT.937/1 from power source to test set connector.

(5) Connect lead UT.937/1 from power source to engine test connector. If a bifurcated lead is used, connect lead from power source to test set connector and to engine test connector.

(6) Refer to fig.501, connect remaining leads as shown.

(7) Energize external power sources (Ref. 24-41-00).

(8) Refer to fig.502, select test set power supply switch ON and check POWER indicator light comes on. Allow 2 minutes for test set to stabilize.

R (9) Proceed as detailed in operations 2.A.(5) and 2.A.(6).

(10) Remove shorting link from pins 17 and 18 of plug 'G'.

C. Functionally Test Amplifier SCA 200 N2 Redatum System Using Test Set UT.1000/1 or UT.1000/2 (Engine On-Wing)

(1) Equipment required:

UT.1000/1	Test set
or	
UT.1000/2	Test set
UT.937/1	Lead
UT.1124/1	Lead (Comprising UT.999/1 and UT.998)
U.999127	Carrying case

(2) Open L.H. hinged cowl 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433DL for engine No.2 (Ref. 71-12-05).

(3) Ensure amplifier test switch (zone 210) and amplifier override switch (zone 215) are set to normal (light out).

(4) Prepare for testing as detailed in operation 2.A.(4).

(5) Test N2 datum setting as detailed in operation 2.A.(5).

(6) Refer to fig.502, set REDATUM switch to AMPLIFIER.

(7) Set N1/N2 INJECT switch to N2.

(8) Set MEASURE N1/N2 switch to N2.

(9) Set T7 INJECT switch to OFF.

(10) Turn N INJECT knobpot fully anti-clockwise.

R (11) Turn READSPEED control to achieve 84 (% N2) on digital display.

(12) Turn N INJECT knobpot clockwise until lowest possible reading is obtained on MOTOR VOLTS gauge, then turn READSPEED control to centre zero GALVO and record digital display reading.

NOTE: If the lowest reading is overshot (i.e. if the voltage commences to rise again) turn the N INJECT knobpot anti-clockwise one full turn and repeat operation.

(13) Check reading recorded in operation (12) is within the limits of 85.5 to 88.5%. If reading is not within limits, reject fuel control amplifier.

(14) Select test set power supply switch OFF.

(15) De-energize ground services system (Ref. 24-41-00).

(16) Disconnect test leads from engine and test set. Fit dust covers to all connectors.

(17) Fit test set cover.

(18) Close L.H. hinged cowl 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433DL for engine No.2 (Ref. 71-12-05).

D. Functionally Test Amplifier Redatum and Override System Using Test Set UT.1000/1 or UT.1000/2 (Engine On-Wing).

CR This test can be used as an alternative to Test No.8, 71-00-00, Adjustment/Test providing an N2 redatum test has been effected on a test bed run prior to engine installation.

(1) Equipment required:

UT.1000/1	Test set
or	
UT.1000/2	Test set
UT.937/1	Lead
UT.1124/1	Lead (Comprising UT.999/1 and UT.998)
U.999127	Carrying case

(2) Open L.H. hinged cowl 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433DL for engine No.2 (Ref. 71-12-05).

(3) Ensure fuel control amplifier test switch (zone 210) and fuel control amplifier override switch (zone 215) are set to normal (light out).

(4) Remove test set cover.

(5) Refer to fig.501, connect test set to engine test connectors as shown.

(6) Connect and energize external power system (24-41-00).

(7) Refer to fig.502, select test set power supply switch ON and check POWER indicator light comes on. Allow 2 minutes for test set to stabilize.

(8) Set SPEED/TEMP switch to SPEED.

(9) Set N1/N2 INJECT switch to N2.

(10) Set T7 INJECT switch to OFF and REDATUM switch to OFF (Centre position).

(11) Set MEASURE N1/N2 switch to N2.

(12) Turn N INJECT knobpot fully anti-clockwise.

(13) Turn READSPEED control to achieve 101 (% N2) on digital display.

(14) Turn N INJECT knobpot clockwise to centre zero GALVO.

(15) Select fuel control amplifier OVRD switch (zone 215) to override position and check light comes on.

(16) While observing FEEDBACK TACHO VOLTS gauge, select fuel control amplifier test switch (zone 210) to reset position. Hold switch in position for 30 seconds and check no feedback voltage is indicated on gauge during this period.

(17) Still holding fuel control amplifier test switch in reset position, select OVRD switch to normal (light out) and check feedback voltage is indicated on FEEDBACK TACHO VOLTS gauge.

(18) If the criteria specified in this test is not met, reject fuel control amplifier.

(19) Select fuel control amplifier test switch (zone 210) to normal position.

(20) Select test set power supply switch OFF.

(21) De-energize ground services system (Ref. 24-41-00).

(22) Refer to fig.501, disconnect test set leads from engine and test set. Fit dust covers to all connectors.

(23) Fit test set cover.

(24) Close L.H. hinged cowl 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433DL for engine No.2 (Ref. 71-12-05).

E. Functionally Test Amplifier SCA 200 Starting Trim Valve Exerciser Using Test Set UT.1000/1 or UT.1000/2 (Engine On-Wing).

CAUTION: ENSURE NO AIR PRESSURE IS APPLIED TO THE ENGINE START SYSTEM WHILE THIS TEST IS BEING EFFECTED.

(1) Equipment required:

UT.1000/1	Test set
or	
UT.1000/2	Test set
UT.937/1	Lead
UT.1124/1	Lead (Comprising UT.999/1 and UT.998)

(2) Ensure appropriate ENG ISLN VALVE switchlight on ENGINE BLEED CONTROL panel (zone 215) is released (out).

(3) Tag appropriate ENG ISLN VALVE switchlight.

(4) Open L.H. hinged cowl 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433DL for engine No.2 (Ref. 71-12-05).

(5) Ensure amplifier test switch (zone 210) and amplifier override switch (zone 215) are set to normal (light out).

(6) Prepare for testing

(a) Remove test set cover.

(b) Refer to fig.501, connect test set to engine test connectors as shown.

(c) Connect and energize external power system (24-41-00).

(d) Refer to fig.502, turn T7 INJECT knobpot fully anti-clockwise.

(e) Select test set power supply switch ON and check POWER indicator light comes on. Allow 2 minutes for test set to stabilize.

(7) Press GROUND START switchlight on pilot's overhead panel (zone 210) and check for a full-scale pulse deflection to right on FEEDBACK TACHO VOLTS gauge.

(8) Press GND START RELEASE switchlight on pilot's overhead panel (zone 210) and check that FEEDBACK TACHO VOLTS gauge shows a small deflection to left, holds, then returns to centre-zero.

(9) If the criteria specified in this test is not met, reject fuel control amplifier.

(10) Select test set power supply switch OFF.

(11) De-energize ground services system (Ref. 24-41-00).

(12) Remove tag from appropriate ENG ISLN VALVE switchlight.

(13) Disconnect test leads from engine and test set. Fit dust covers to all connectors.

(14) Fit test set cover.

(15) Close L.H. hinged cowl 413A or 423A for engine No.1 and 3 (Ref. 71-11-00) or 433DL for engine No.2 (Ref. 71-11-05).

3. Scheduled Maintenance Test of Speed Governing System (Non-Mod S.B.73-3673) - Rolls-Royce Test Set

This test must only be effected as directed by Non-Mod. S.B.73-3673.

R NOTE: If test set is not available TEST No.9 - Speed and
R temperature control amplifier redatum test (Ref. 71-00-00)
R can be performed as an alternative.

A. Equipment Required.

UT1000/1	Test set
or	
UT1000/2	Test set
UT937/1	Lead
UT1124/1	Lead (Comprising lead UT998 and lead UT999/1)
U999127	Carrying case

B. Installed Engine - Preparation

(1) Open appropriate L.H. hinged cowl 413A (Eng.1), 423A (Eng.3) or 433DL (Eng.2).

(2) Ensure amplifier test switch (Zone 210) and override switch (Zone 215) are set to normal.

(3) Refer to fig.501, connect UT1124/1 and UT937/1.

(4) Energize ground services system (Ref. 24-41-00).

(5) Refer to fig.502, turn N INJECT knobpot fully anti-clockwise.

(6) Select power switch to ON and allow 2 minutes for set to stabilize.

C. Non-installed Engine - Preparation

(1) Identify pins 17 and 18 of Engine/Pylon Interface plug 'G' 9811-P704 and fit locally manufactured shorting link to them.

NOTE: Pin number 1 is centre pin. Count pins clockwise following white spiral line.

(2) Remove test set cover.

A 115 volts, 400 Hz A.C. supply is required to both engine and test set. To achieve this, use either two leads UT937/1 with separate external power sources or a bifurcated lead of local manufacture.

(3) Refer to fig.501 and connect lead UT937/1 from power source to test set connector.

(4) Connect lead UT937/1 from power source to engine test connector. If a bifurcated lead is used, connect lead from power source to test set connector and to engine test connector.

(5) Refer to fig.501, connect leads UT998 and UT999/1.

(6) Turn N INJECT and T7 INJECT knobpots fully anti-clockwise.

(7) Energize ground services system (Ref. 24-41-00).

(8) Refer to fig.502, select POWER switch to ON and check POWER indicator light comes on. Allow 2 minutes for set to stabilize.

D. Test Procedure

For identification of switches and gauges in this procedure, refer to fig.502.

(1) Set REDATUM switch to SPEEDSWITCH.

(2) Set T7 INJECT switch to OFF.

(3) Set GALVO switch to SPEED.

(4) Set N1/N2 INJECT switch to OFF.

(5) Turn N INJECT knobpot fully clockwise.

(6) Set N1/N2 INJECT switch to N2 and check for large deflection (full scale) on FEEDBACK TACHO VOLTS gauge and subsequent return to zero of the gauge needle.

(7) Set N1/N2 INJECT switch to OFF and check for small deflection, in opposite direction to that observed in (6), on FEEDBACK TACHO VOLTS gauge and subsequent return to zero of the gauge needle.

(8) Turn N INJECT knobpot fully anti-clockwise.

(9) Set REDATUM switch to OFF.

(10) If the criteria specified in this test is not met, refer to 73-00-00, Fuel and Control - Fault Isolation.

E. Turn T7 INJECT knobpot fully anti-clockwise.

F. Refer to fig.501, select POWER switch to OFF.

G. De-energize ground services system (Ref, 24-41-00).

H. Disconnect and remove test leads; fit dust covers to all connectors.

J. On non-installed engines; remove shorting link from Engine/ Pylon interface plug G.

K. On installed engines; close appropriate hinged cowl 413A (Eng.1), 423A (Eng.3) or 433DL (Eng.2).

R 4. Adjust Speed Control Amplifier SCA 200

A. Adjust N2 Datum Setting

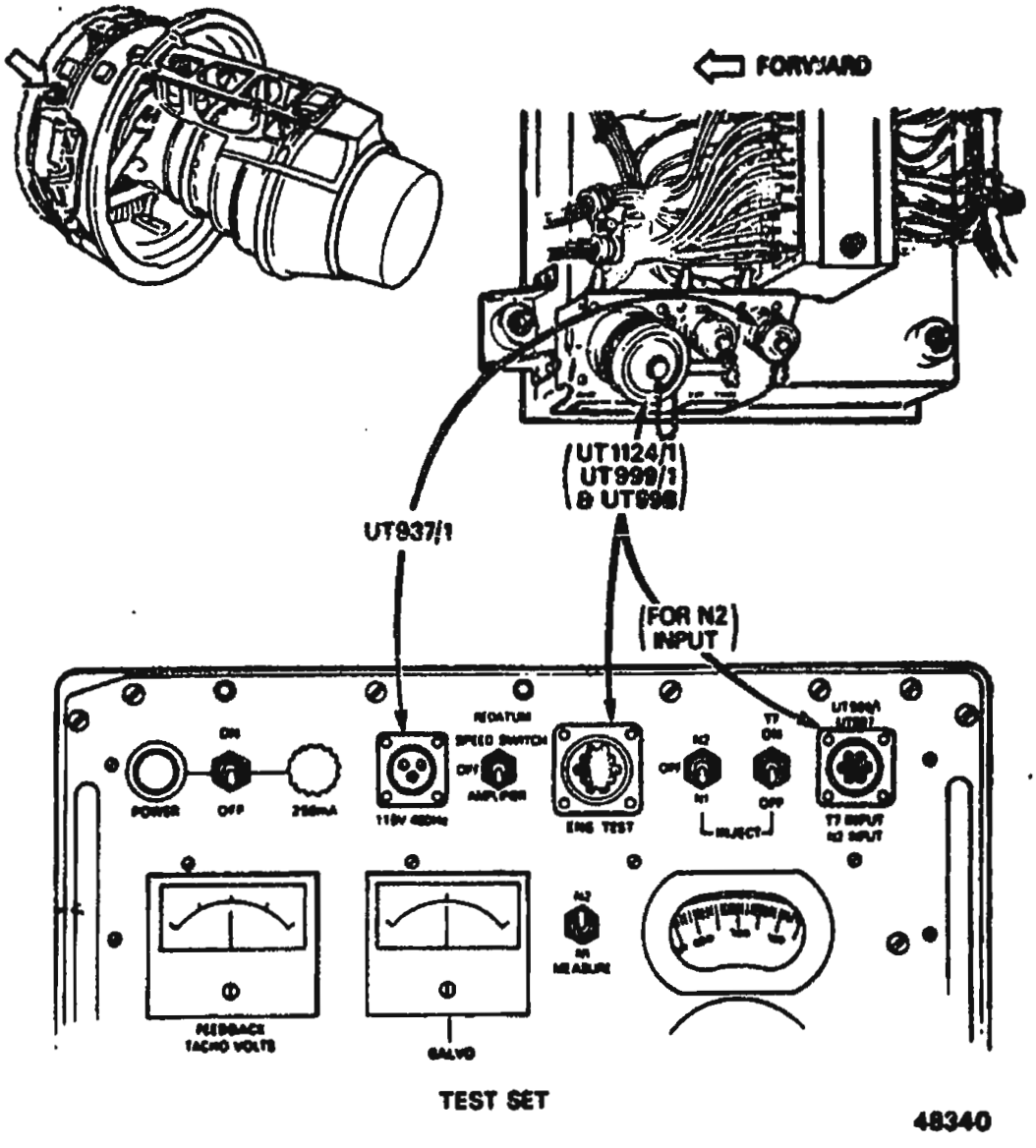
(1) Equipment required:

T.496300 Adjusting key

(2) Refer to Fig.503, using key T.496300, turn adjuster clockwise to increase datum setting or anti-clockwise
R to decrease datum setting. One turn of adjuster alters N2 speed approximately 0.7 per cent.

NOTE: The adjuster is only lightly loaded and care should be taken when making adjustment.

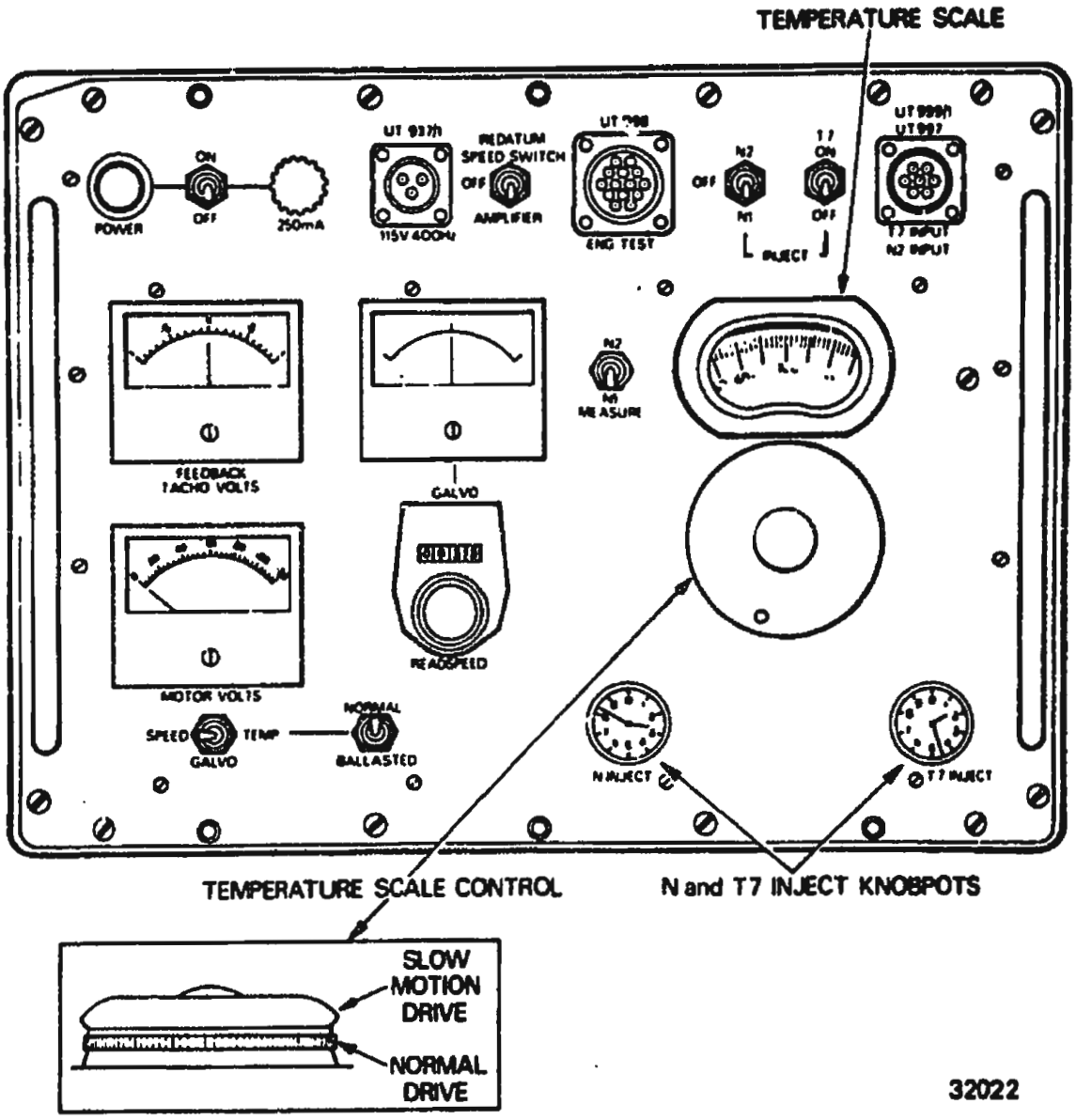
(3) Functionally re-test amplifier N2 datum setting (Ref. para.2.A.(5)).



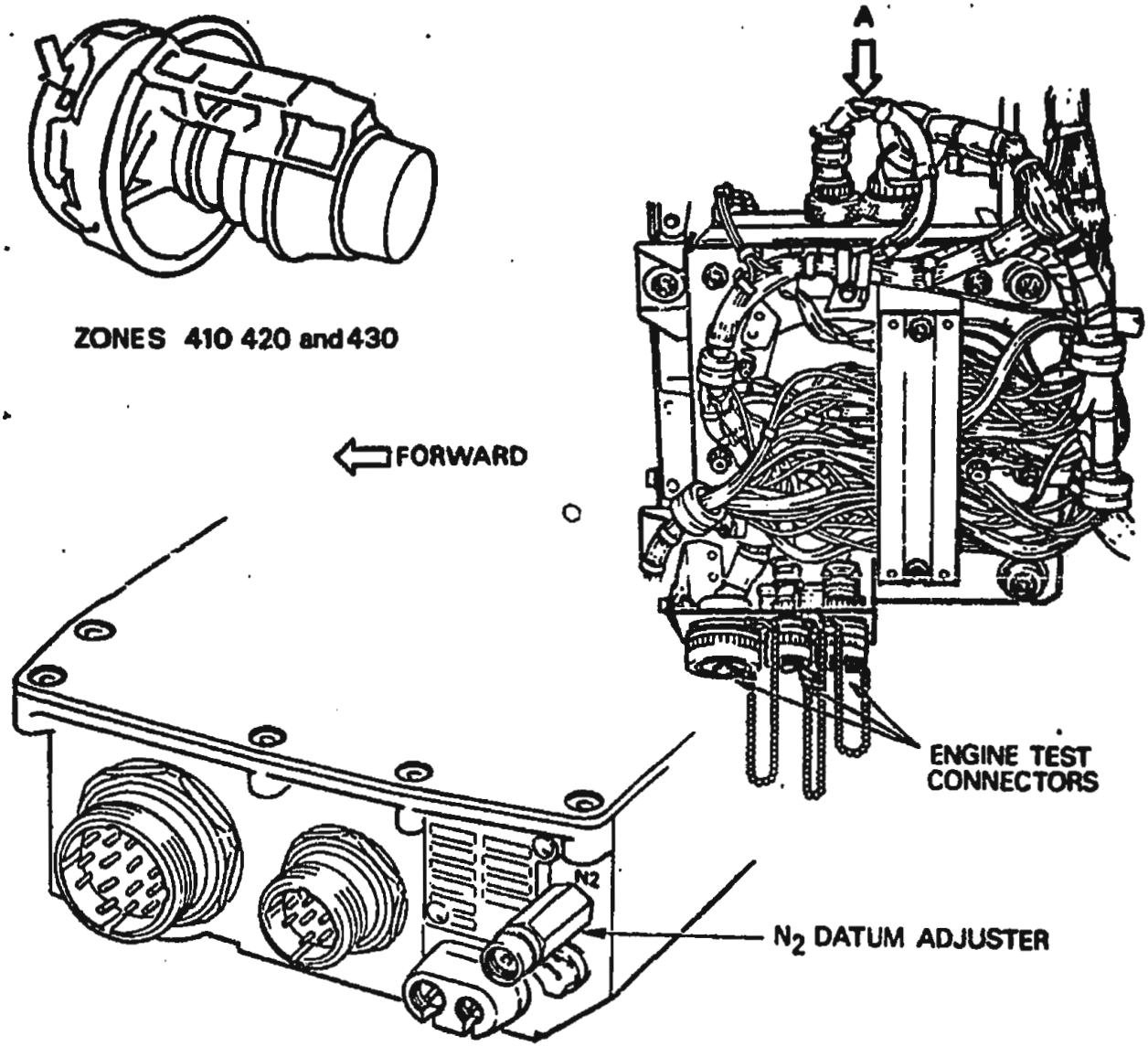
TEST SET

48340

Test set UT.1000/1 or UT.1000/2 to engine, test lead connections
Fig.501



Test set UT.1000/1 or UT.1000/2 front panel
Fig.502



VIEW ON A (Amplifier front face) CONNECTORS AND HARNESSES OMITTED FOR CLARITY

78463

Amplifier SCA 200 adjustment
Fig.503

FUEL FLOW REGULATOR - MAINTENANCE PRACTICES

The servicing, removal and installation procedures detailed in this section are as follows:

	Paragraph	Procedure
	1.	Servicing Air Throttle Valve
	A.	Clean Fuel Flow Regulator Air Throttle Valve
	2.	Removal/Installation Fuel Flow Regulator
	A.	Remove fuel flow regulator
	B.	Inhibit fuel flow regulator
	C.	Install fuel flow regulator
	3.	Removal/Installation P4 Filter
	A.	Remove P4 filter
	B.	Prepare to install P4 filter (Cleaning)
	C.	Install P4 filter
C	4.	Removal/Installation P4P Filter (Deleted)
	5.	Removal/Installation Splitter Assembly
	A.	Remove splitter assembly
	B.	Prepare to install splitter assembly (Cleaning)
	C.	Install splitter assembly
C	6.	Introduction of Recalibrated Fuel Flow Regulator,
C		TWA Stk. Nbr. 29219
CR	7.	RB211 Fuel Flow Regulator - Air Side Wash Procedure

1. Servicing Air Throttle Valve

A. Clean Fuel Flow Regulator (F.F.R.) Air Throttle Valve.

(1) Material Required:

	British Spec./Ref.	American Spec./Ref.	OMat Item No.
Cleaning Agent	White Spirit B.S.245 or Stoddards Solvent Type 1	MIL-C-7024C TYPE 2 ASTM D484-52	102 102A

(2) Open left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL for engine No.2 (Ref. 71-12-01).

(3) Refer to fig.203 (sheet 1), disconnect throttle control rod (3) from F.F.R., move air throttle lever to fully open position and check stiffness of air throttle valve.

(4) With throttle lever in fully open position, spray the air throttle valve profile plate preferably through 0.2in. dia. drain hole next to Max. forward throttle stop screw on throttle cover, or through screened vent at bottom of F.F.R. air throttle valve housing.

(5) Exercise the air throttle lever several times to ensure free movement of plate lever over the profile plate. Ensuring that the air throttle lever returns to the ground idle position under the action of its own spring.

(6) CAUTION: THE 'MESSERSCHMITT' ADJUSTER ON THE FUEL FLOW REGULATOR AIR THROTTLE LEVER IS RIG SET DURING F.F.R. BUILD TO GIVE THE CORRECT ANGULAR RELATIONSHIP BETWEEN THE LEVER AND THE THROTTLE INPUT SHAFT AND MUST NOT BE USED TO EFFECT CONTROL SETTING.
Set power control linkage and connect throttle control rod (3) (Ref. 76-11-00 Adjustment).

(7) Close left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL for engine No.2 (Ref. 71-12-01).

R

2. Removal/Installation Fuel Flow Regulator

Service Bulletins referred to:

S.B.72-2564 Support brackets from gearbox flange to fuel pumps and fuel flow regulator
S.B.71-2577 Additional harness clipping.
S.B.73-3502 P1 tube to fuel flow regulator - re-run and additional clipping
Lucas S.B. F.F.R.101-73-23 (Mod. CP.4540) - Introduction of revised G.I. orifice to provide increased idling speed
S.B.73-5160 Introduction of Centrisep Air Cleaner
S.B.72-3878 - Introduction of thickened front and rear H.S. gearbox housings (Deletion of F.F.R. support bracket)
R S.B.71-2831 - Introduction of tell-tale drains system -
R tubes and fittings.

Referenced Procedures

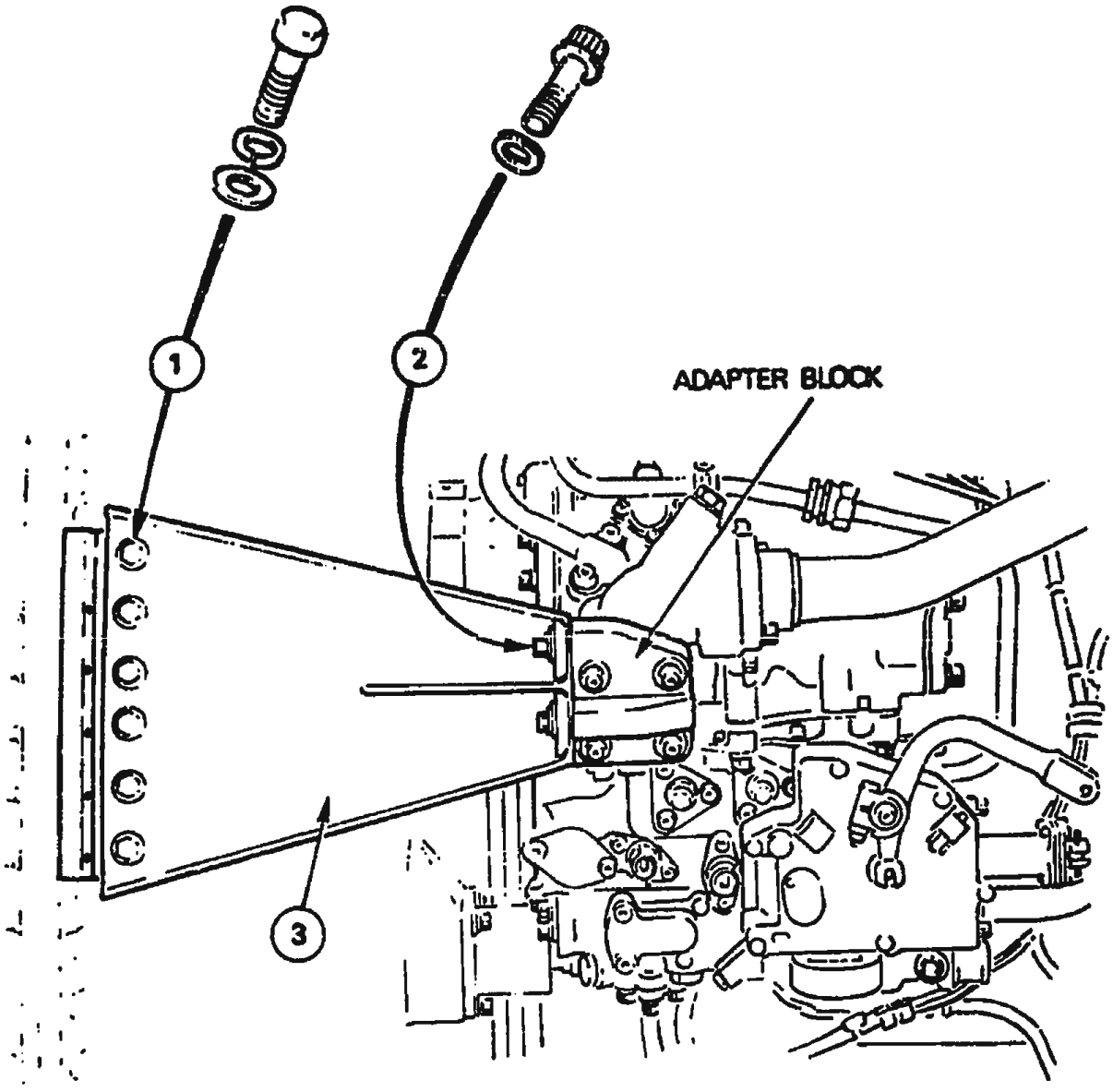
70-02-01 Identification, Lubrication and Fitting of Rubber Sealing Rings
70-12-02 Fitting Vee Band Coupling Clamps
70-51-00 Torque Tightening Techniques
71-00-00 Fuel Flow Regulator - Adjustment/Test
71-11-00 Cowling, Engines No.1 and No.3 - Servicing
71-12-01 LH and RH Lower Hinged Cowl - Servicing
73-00-00 Engine Fuel and Control - Servicing
73-11-09 Fuel Tubes - Maintenance Practices
76-11-00 Engine Controls - Adjustment/Test

Illustrated Parts Catalogue References

The I.P.C. sections where parts disturbed during the following operations can be located are as follows:

71-50-01 Electrical Harness
71-70-02 Engine Drains
73-11-09 Fuel Supply System
73-21-01 Fuel Flow Regulator Installation
73-21-04 Fuel System Air Tubes
76-11-02 Engine Power and Thrust Reverser Control Linkage

R WARNING: BE CAREFUL WHEN YOU MOVE THE FUEL FLOW REGULATOR.
R BECAUSE THE F.F.R. DRY WEIGHT IS APPROXIMATELY
R 50 POUNDS (23 KG), INJURY CAN OCCUR.



1. Bolt, spring washer and spreader washer (6 off)
2. Bolt and washer (2 off)
3. Support bracket

29962

R Fuel flow regulator support bracket disconnect points
R Fig.201

A. Remove Fuel Flow Regulator

(1) Equipment required:

CP.20968/3 - Beam sling
Clean receptacle - minimum capacity

5 U.S. gallons
4 Imperial gallons
18 Litres

Flexible hoses - approximate length 72in. (1800 mm.)
internal diameter 0.5in. (12 mm.)

R Small brush and yellow paint (OMat 799) or equivalent.

(2) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag appropriate FUEL FLOW circuit breaker.

(3) On pilots overhead control panel, zone 210, pull appropriate Fire Emergency Shut-off Control.

(4) Open left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL for engine No.2 (Ref. 71-12-01).

(5) Drain engine L.P. fuel system (Ref. 73-00-00).

(6) On engines with S.B.72-2564, refer to fig.201, remove bolts, spring washers and spreader washers (1), bolts and washers (2) and support bracket (3).

(7) CAUTION: ENSURE ELECTRICAL CONNECTORS ARE FREE FROM SOLID AND/OR LIQUID CONTAMINATION BEFORE DISCONNECTING. FAILURE TO DO SO COULD RESULT IN A FIRE.

Refer to fig.203 (Sheet 1), disconnect electrical connectors (1) and (2).

(8) Disconnect throttle control rod (3).

(9) On RB211-22B-02/10 (A.I.D.S.) engines only, disconnect connector (4) and release fuel tube support clip from P1 air tube support clip. Leave clips attached to tubes.

(10) On engines with S.B.72-2564, disconnect connector (5) and remove adapter block (8) and spacers (9).

On engines without S.B.72-2564 or with 72-3878, disconnect connector (5).

(11) Disconnect connector (6) and remove tube assembly (7). On engines with S.B.71-2577 leave bracket at connector (6) attached to harness.

(12) Disconnect connector (10).

(13) Remove tubes (11), (12) and (13).

(14) Refer to fig.203 (Sheet 2) disconnect connectors (17) through (19). Leave bracket (28) at connector (19) attached to tube support clip.

On engines with S.B.73-3502, leave bracket (27) attached to tube support clip.

(15) On RB211-22B-02/10 (A.I.D.S.) engines only, disconnect connector (21) and release fuel tube support clip from P4 air tube support clip. Leave clips attached to tubes.

(16) On engines without S.B.73-5160, disconnect tube (16) as detailed in 3.A. (3).

On engines with S.B.73-5160, disconnect and remove adapter assembly (16), leave harness and tube connected to brackets.

(17) Disconnect connector (20) and release drain tube and harness clips from brackets.

R On engines with S.B.71-2831 disconnect at connector (20)
R and disconnect point and remove drain tube.

R NOTE: To ensure correct refittment, it is recommended
R that the FFR drain tube is identified by painting
R two yellow bands either side of the disconnect
R point - refer to Fig.203 (Sheet 3).

(18) Prepare for lifting.

(a) Fit and secure lifting beam to engine left-hand handling housing.

(b) Attach arm assembly to hoist at pivot nearest to end of arm marked REGULATOR END.

(c) Secure REGULATOR END of arm assembly to L.P. return and drains outlet apertures on regulator.

(19) Take weight of regulator on hoist then remove (Ref. 70-12-02) clamp (22) withdraw unit from gearbox and lower onto a work surface.

(20) Disconnect arm assembly from regulator.

(21) Remove connector (23) and adapter (24); retain for fitment to new regulator.

(22) Fit blanks to all exposed apertures and connectors.

(23) Inhibit regulator as detailed in 2.B.

B. Inhibit Fuel Flow Regulator

Inhibiting can be delayed for up to 48 hours providing all connectors and apertures are blanked immediately following unit removal.

Fuel aperture identifications given below refer to those marked on the unit.

CAUTION: BEFORE ANY INHIBITING IS COMMENCED FIT APPROVED COVERS AND GASKETS TO FUEL DRAIN APERTURE, P1, P3 AND P4 AIR INLET APERTURES AND MASK OFF P4J VENT/FILTER AND GROUND IDLING SOLENOID VENTS.

(1) Equipment required:

T.433739 Spanner
Fluid container, fitted with fine mesh filter

(2) Material required:

	British Spec./Ref.	American Spec./Ref.	OMat Item No.
Inhibiting oil	DTD.5578	MIL-L-7870A	1029
or	or	or	
Mineral oil	DEF.2001-A	MIL-L-6081C A.S.6. (grade 1010)	1003A
White spirit	BS.245	-	102
or			
Solvent	-	A.S.T.M. D484-52	1/5

(3) Fit blanking caps to electrical connectors.

(4) Drain all fuel from regulator.

(5) Fit covers and gaskets to all apertures and mask of all vents.

(6) Thoroughly clean exterior of regulator with white spirit or solvent, then dry unit.

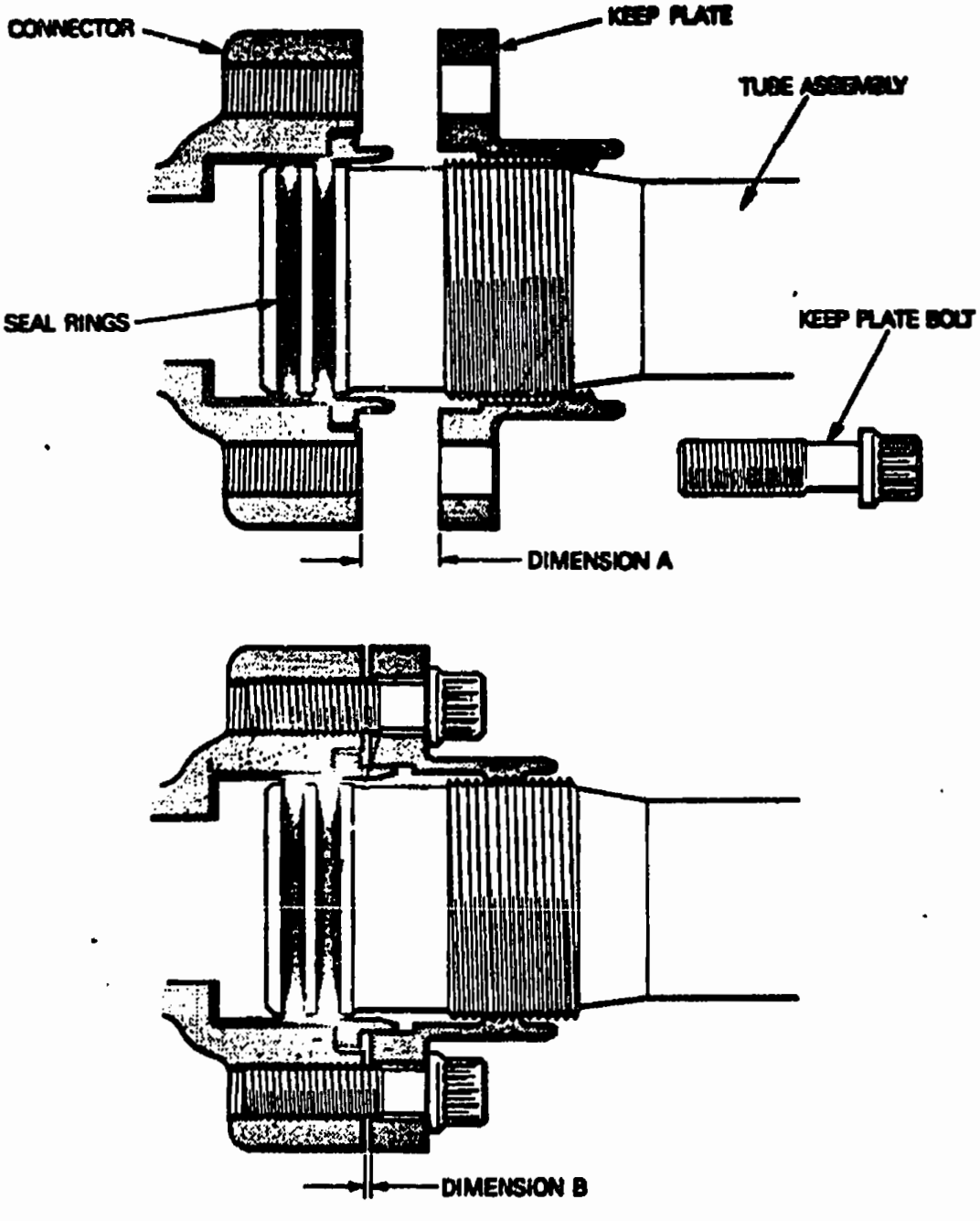
(7) Excluding fuel drain, remove covers and gaskets from fuel apertures.

(8) Position regulator, with H.P. inlet uppermost then, whilst rotating the drive shaft with spanner T.433739, pour inhibiting fluid into main inlet until it issues from main, enrichment and spill outlet apertures. Refit covers and gaskets to 3 outlet apertures. During this operation rotate drive shaft through at least 6 revolutions.

(9) Pour inhibiting fluid into H.P. inlet until full, then refit cover and gaskets.

(10) Pour inhibiting fluid into L.P. aperture until full then refit covers and gasket.

(11) Turn the regulator over several times to distribute oil, then top up level by removing and refitting fuel aperture covers and gaskets in turn. Repeat this operation until unit is completely full.



Fuel tube end connector adjustment
Fig.202

(12) Clean and dry exterior of regulator then examine the covers for signs of leakage. Renew any defective gaskets, topping up fluid level as required.

(13) Attach label to regulator recording date and details of inhibiting.

C. Install Fuel Flow Regulator

Refer to 73-11-09 for correct procedure for fitting fuel tubes.

CAUTION: 1. ENGINES WITH S.B.72-8700 MAY HAVE THE FOLLOWING F.F.R. INSTALLED AS AN ALTERNATIVE:

F.F.R.101 MK.10 IN PLACE OF F.F.R.101 MK.14.

IF AN ALTERNATIVE F.F.R. IS INSTALLED TEST 14 (71-00-00 ADJUSTMENT/TEST) AND THE REQUIREMENTS OF S.B.72-8700 MUST BE CARRIED OUT. THE F.F.R. MUST BE RE-IDENTIFIED AS FOLLOWS:

F.F.R.101 MK.10 BECOMES F.F.R.101 MK.12.

2. ENGINES WITHOUT S.B.72-8700 MAY HAVE THE FOLLOWING F.F.R.'S INSTALLED AS ALTERNATIVES:

F.F.R.101 MK.12 OR MK.14 IN PLACE OF F.F.R.101 MK.10.

THROTTLE LEVER LAG OF UP TO 1/4 KNOB MAY OCCUR BETWEEN ENGINES WITH AN ALTERNATIVE F.F.R. INSTALLED (MK.12 OR 14) AND ENGINES THAT HAVE F.F.R.101 MK.10 INSTALLED.

3. FUEL FLOW REGULATORS 101-MK7 (LUCAS MOD. CP.4812) MUST ONLY BE FITTED TO ENGINES INCORPORATING S.B.78-3282 - DEACTIVATION OF HOT STREAM SPOILER SYSTEM, OR S.B.78-2969 - DELETION OF HOT STREAM SPOILER SYSTEM AND INTRODUCTION OF 11 DEGREE EXHAUST COLLECTOR.

4. FUEL FLOW REGULATORS 101-MK 10 AND 11 (LUCAS MOD CP.5247) MUST ONLY BE FITTED TO ENGINES INCORPORATING S.B.71-4176 - GENERAL SERVICES LOOM ASSEMBLY MODIFIED TO SUIT INCREASED CAPACITY TURBINE.

(1) Equipment required

CP.20968/3 - Beam sling
Clean receptacle - minimum capacity

1 U.S. gallon
1 Imperial gallon
4 Litres

(2) Material required:

	British Spec./Ref.	American Spec./Ref.	OMat Item No.
Lockwire	DTD.189A 22 S.W.G.	- 21 A.W.G.	238

(3) Ensure appropriate systems are deactivated as detailed in operations A. (2) and (3).

(4) Position regulator on work surface.

(5) Remove blanks and gaskets, from all fuel apertures and drain off inhibiting fluid.

(6) Remove blanksand gaskets, from P1, P3 and P4 air inlet apertures, minimum V.M.O. solenoid and ground idling reset solenoid, and ensure P4J and ground idling solenoid vents are clear.

(7) Refer to A, fig.203 (Sheet 2). fit a new washer to adapter (24) then fit and tighten adapter to regulator and wirelock.

(8) Refer to fig.203 (Sheets 1 and 2), ensure all mating aperture and connector faces are clean and free from damage.

(9) Fit and lubricate (Ref. 70-02-01) a new seal ring to connector (23).

(10) Fit connector (23) to inlet aperture with tube inlet facing away from regulator drive end, secure with bolts and washers.

(11) Fit and lubricate (Ref. 70-02-01) a new seal ring (25) to regulator mounting shoulder and a new seal ring (26) to groove on input coupling.

(12) Ensure end of the acceleration friction locked adjuster is 1/2 of a turn above the end of the surrounding sleeve (Ref. fig.205). Adjust friction locked adjuster if necessary.

(13) Fit and lubricate (Ref. 70-02-01) new seal rings to disturbed fuel connectors and tubes.

(14) Prepare clamp (22) and mounting flanges for fitment (Ref. 70-12-02).

(15) Fit beam sling to engine and secure arm assembly to regulator as detailed in operation A. (18).

(16) Lift regulator with hoist and fit to mounting pad on high-speed external gearbox, ensuring positive location on dowel, then fit and secure (Ref. 70-12-02) clamp (22).

(17) Disconnect arm assembly from regulator and remove beam sling from engine.

(18) On engines without S.B.73-5160, connect tube (16) as detailed in 3.C. (5).

On engines with S.B.73-5160, fit and secure adapter assembly (16), ensure brackets are correctly located.

(19) On RB211-22B-02/10 (A.I.D.S.) engines only, connect and tighten (Ref. 70-51-00) connector (21) then wirelock. Secure support clip to P4 air tube support clip.

R (20) Correct and secure connectors (18) and (17).

R (21) Connect and secure connector (20). Fit and secure drain
R tube and harness clips to brackets.

R On engines with S.B.71-2831 fit drain tube and secure
R connector (20). Secure at tube disconnect point
R (Ref. 70-51-00) and wirelock.

R CAUTION: ENSURE F.F.R. DRAIN TUBE IS NOT CONFUSED WITH
R FUEL PUMP DRAIN TUBE EITHER SIDE OF DISCONNECT
R POINT.
R Refer to Fig.203 (Sheet 3).

R (22) Position bracket (28) on connector (19), then fit and secure connector.

On engines with S.B.73-3502, position brackets (28) and then (27) on connector (19), then fit and secure connector.

R (23) Fit and secure tube (13). Refer to 70-51-00 for tightening tube disconnect. Wirelock tube disconnect.

CR (24) CAUTION: AFTER INSTALLATION OF TUBE (11) A VISUAL
C CHECK OF THE INLET ADAPTER TO TUBE IS
C REQUIRED. THIS CHECK MUST BE DONE WITH
C A MIRROR DUE TO THE INACCESSIBLE AREA.
C PAY PARTICULAR ATTENTION TO THE AREA ADJACENT
C TO THE INBOARD BOLT. (REFER TO FIG.203
C SHT.1). DO NOT DEPEND ON FUEL LEAK ONLY.
Fit and secure tubes (12) and (11).

R (25) Connect and tighten (Ref. 70-51-00) connector (10) and wirelock.

R (26) Adjust, fit and secure tube (7) as follows:

(a) Refer to fig.203 (sheet 1), remove bolts (14) and remove connector (5) from tube end.

(b) Screw keep plate (15) anti-clockwise until clear of threads on tube assembly (7).

(c) Fit and lubricate (Ref. 70-02-01) new seal rings to tube end.

(d) Start keep plate (15) on tube threads.

(e) Fit connector (5) to tube end.

(f) Fit and secure tube assembly (7) to regulator and fuel shut-off valve.

(g) Measure and record distance between face of keep plate and connector (dimension A, ref.fig.202).

(h) Remove tube assembly (7), taking care not to alter position of keep plate (15).

(j) Divide dimension A by 0.025in. (0,635 mm.) round off the result to the nearest whole number then screw keep plate (15) clockwise this number of half turns.

(k) Fit tube assembly (7) and secure connectors (5) and (6). Check clearance between connector and keep plate (dimension B, ref.fig.202) is not greater than 0.012in. (0,305 mm.) then fit and secure bolts (14).

On engines with S.B.72-2564, fit spacers (9) and adapter (8) at connector (5).

On engines with S.B.71-2577, fit bracket under lower bolt heads at connector (6).

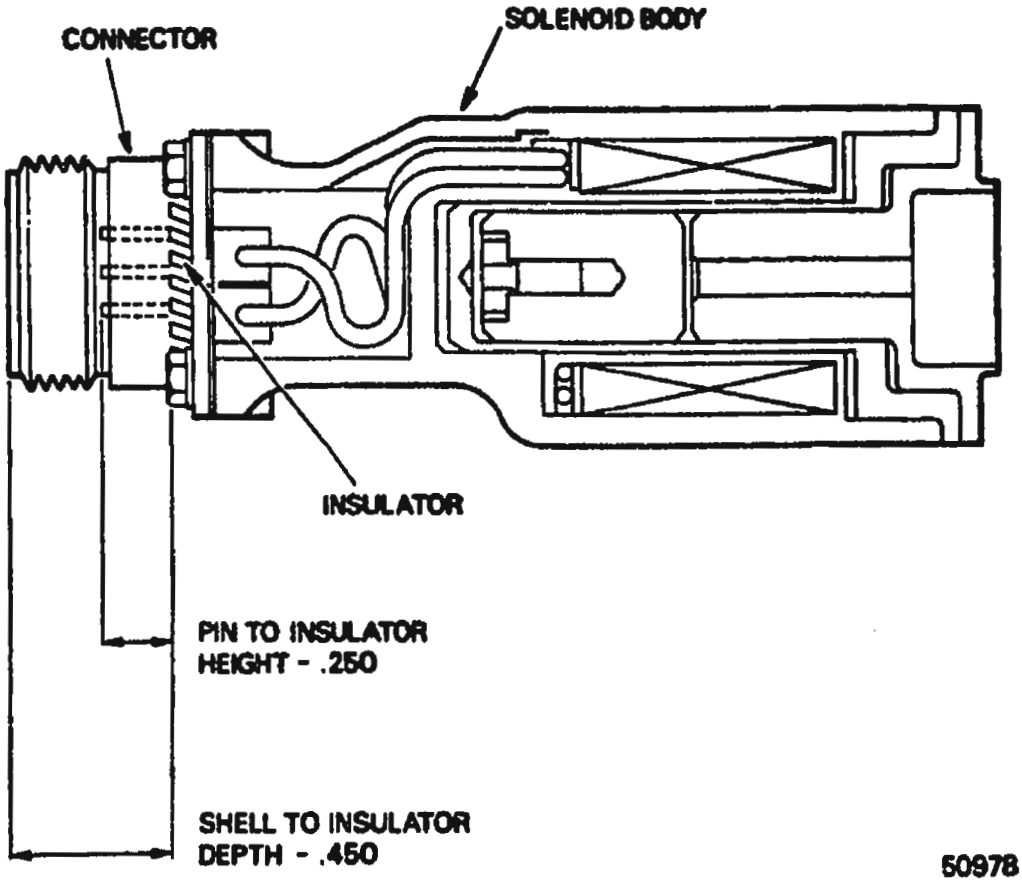
R (27) On RB211-226-02/10 (A.I.D.S.) engines only, connect and tighten (Ref. 70-51-00) connector (4) and wirelock. Secure support clip to P1 air tube support clip.

R (28) CAUTION: THE 'MESSERSCHMITT' ADJUSTER ON THE FUEL FLOW REGULATOR AIR THROTTLE LEVER IS RIG SET DURING F.F.R. BUILD TO GIVE THE CORRECT ANGULAR RELATIONSHIP BETWEEN THE LEVER AND THE THROTTLE INPUT SHAFT AND MUST NOT BE USED TO EFFECT CONTROL SETTING.
Set power control linkage and connect throttle control rod (3) (Ref. 76-11-00).

CR (29) CAUTION: 1. ENSURE ELECTRICAL CONNECTORS ARE FREE FROM LIQUID AND/OR SOLID CONTAMINATION BEFORE CONNECTING. FAILURE TO DO SO COULD RESULT IN A FIRE.

C 2. ASSURE CONNECTOR IS FREE OF INSULATOR
C FROM REMOVED UNIT, (REF. FIG.202A).
Connect and secure electrical connectors (2) and (1).

R (30) On engines with S.B.72-2564 refer to fig.201, position support bracket (3), fit and lightly tighten bolts and washers (2) and bolts, spring washers and spreader washers (1). Ensure support bracket (3) is in contact with face of adapter block then tighten bolts (1) and finally tighten bolts (2).



C
C Ground Idle Solenoid
Fig.202A

R (31) Reactivate systems deactivated in operations A.(2) and (3).

R (32) Prime L.P. fuel system (Ref. 73-00-00).

R (33) Test fuel flow regulator (Ref. 71-00-00, Table 501) and examine for leaks at points disturbed.

R (34) Close left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL for engine No.2 (Ref. 71-12-01).

3. Removal/Installation P4 Filter

Service Bulletins referred to:

Lucas S.B.FFR101-73-48 (Mod.CP.4951) - Introduction of extraction ribs on P4 air filter
S.B.73-5160 - Introduction of Centrisep Air Cleaner

Referenced Procedures

70-51-00 Torque Tightening Techniques
71-11-00 Cowling, Engines No.1 and No.3 - Servicing
71-12-01 LH and RH Lower Hinged Cowl - Servicing

Illustrated Parts Catalogue References

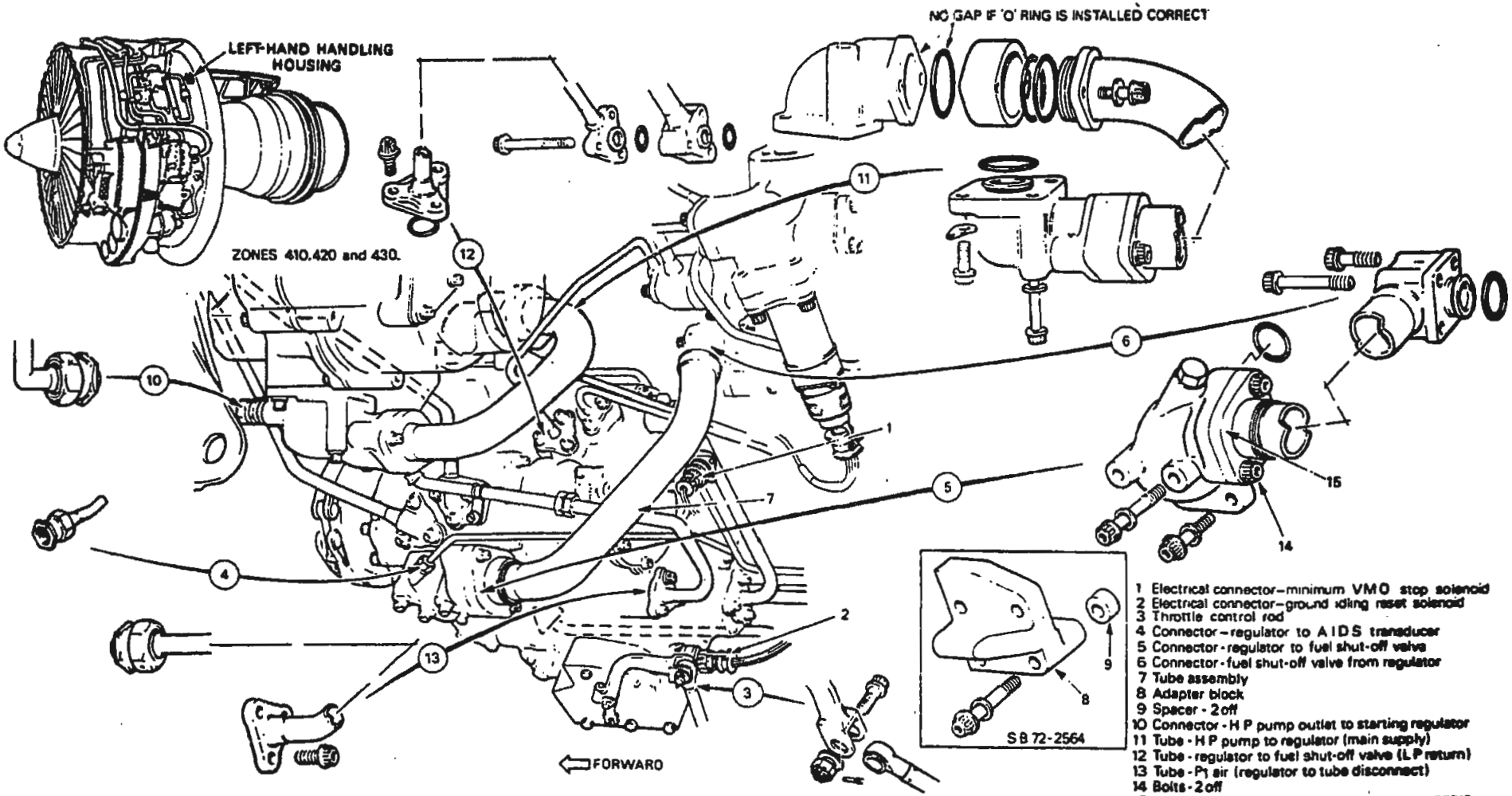
The I.P.C. sections where parts disturbed during the following operations can be located are as follows:

73-21-01 Fuel Flow Regulator Installation
73-21-04 Fuel System Air Tubes

A. Remove P4 Filter

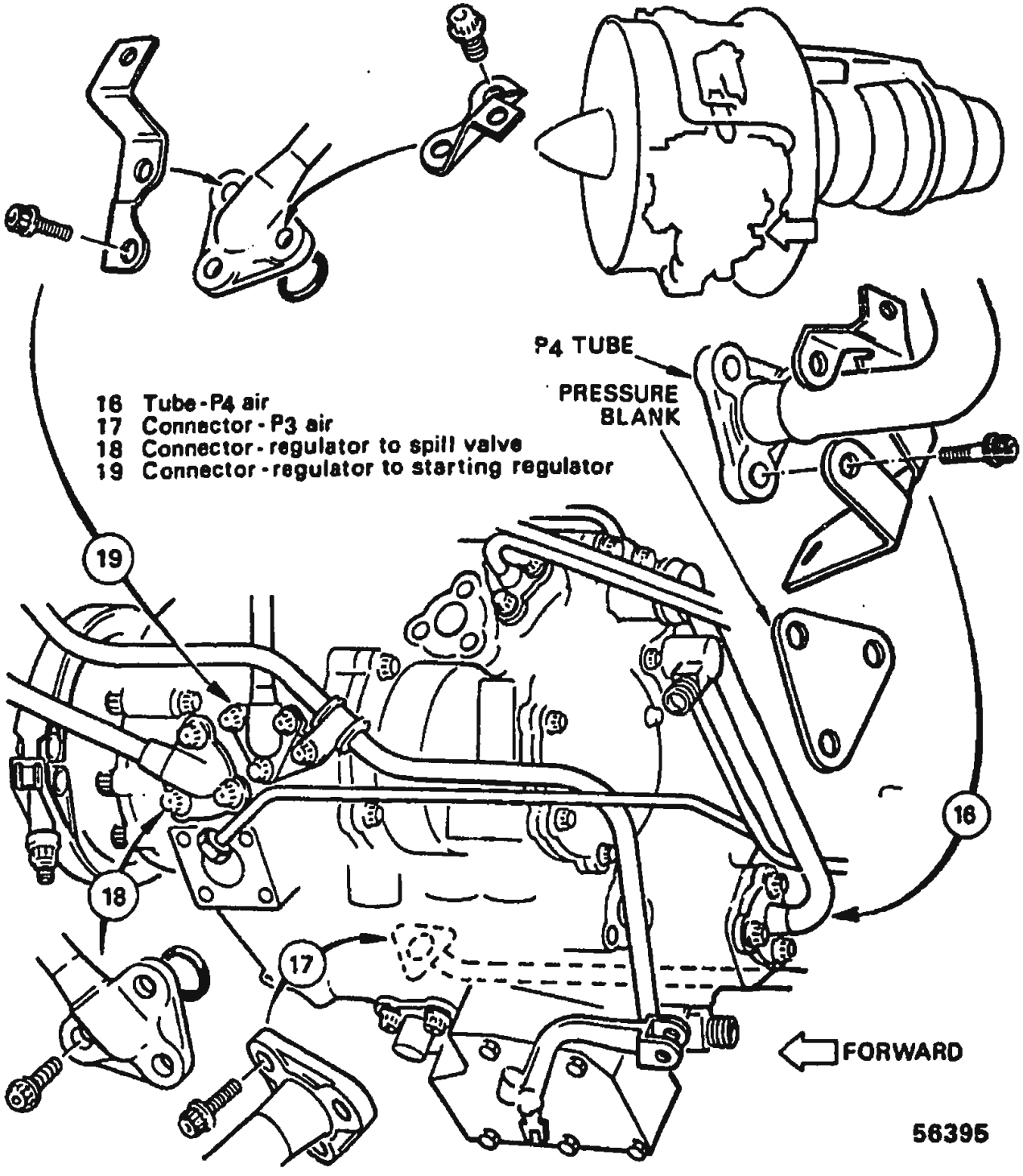
(1) Equipment required:

T.466539 Extractor (pre Lucas S.B.FFR101-73-48)
T.459640 Extractor

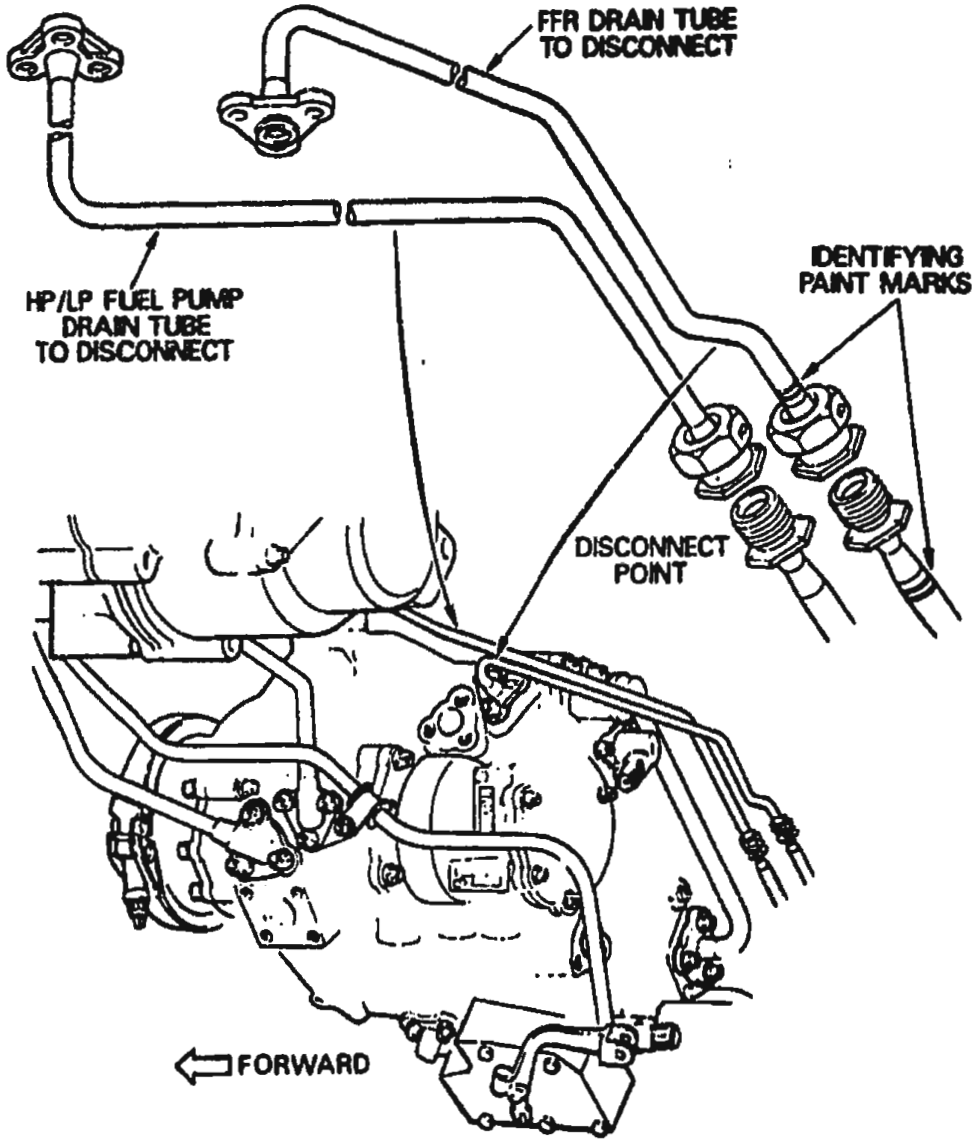

NO GAP IF 'O' RING IS INSTALLED CORRECT
LEFT-HAND HANDLING HOUSING
ZONES 410.420 and 430.
FORWARD
SB 72-2564
1 Electrical connector–minimum VMO stop solenoid
2 Electrical connector–ground idling reset solenoid
3 Throttle control rod
4 Connector–regulator to AIDS transducer
5 Connector-regulator to fuel shut-off valve
6 Connector-fuel shut-off valve from regulator
7 Tube assembly
8 Adapter block
9 Spacer - 2 off
10 Connector - H P pump outlet to starting regulator
11 Tube - H P pump to regulator (main supply)
12 Tube - regulator to fuel shut-off valve (L P return)
13 Tube - P3 air (regulator to tube disconnect)
14 Bolts - 2 off
15 Keep plate
65315

CR Fuel flow regulator disconnect points
CR Fig.203 (Sheet 1)

EFFECTIVITY: ALL



Fuel flow regulator disconnect points
Fig.203 (Sheet 2)



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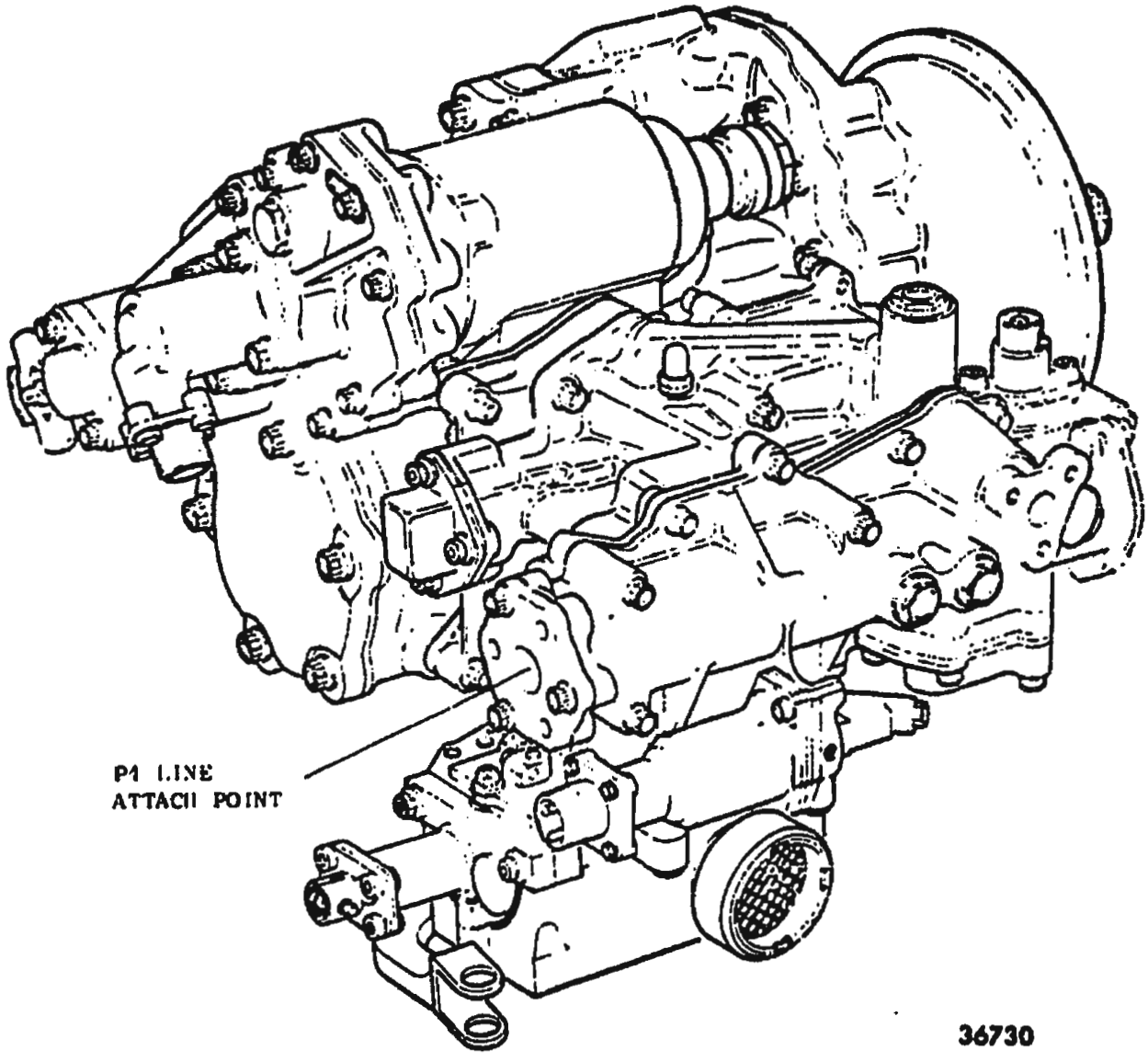
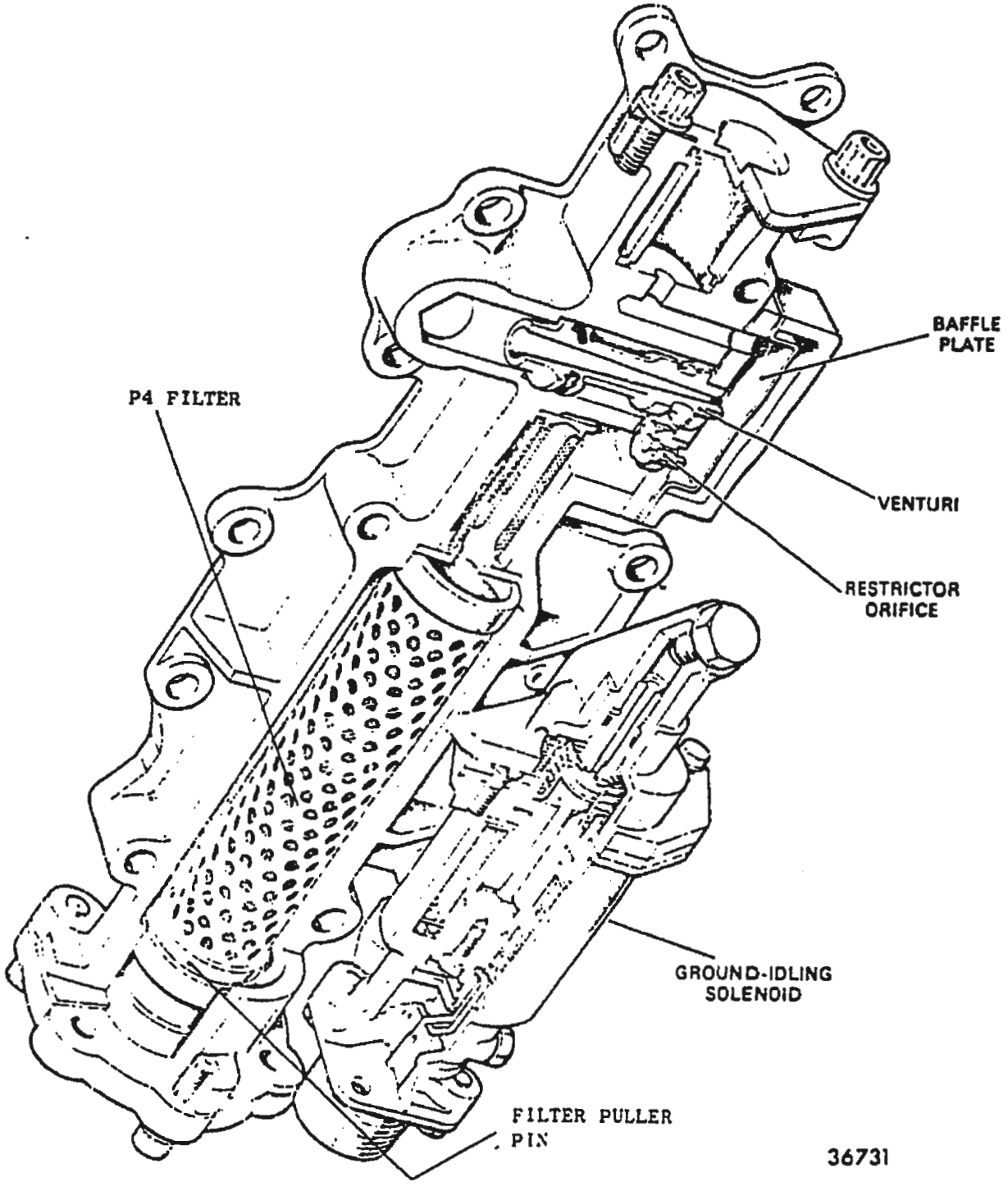
R Fuel flow regulator disconnect points - Engines with S.B.71-2831
R Identification of F.F.R. and H.P./L.P. fuel pump drain tube
R Fig.203 (Sheet 3)



C
C Fuel flow regulator
Fig.203A



Cut-away view of filter and splitter housing
Fig.203B

(2) Open left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL for engine No.2 (Ref. 71-12-01).

(3) On engines without S.B.73-5160, refer to fig.204, release harness clip (1) and (2) from P4 air tube. Leave clips on harness.

(a) Release tube clip (3) from L.P. compressor case. Leave clip on tube.

(b) Release harness and tube clips from bracket at connector (6). Leave clips on harness and tubes.

(c) Disconnect connectors (4), (5) and (6)

(d) Move P4 tube sufficiently to allow P4 filter to be withdrawn from housing in operation A.(6).

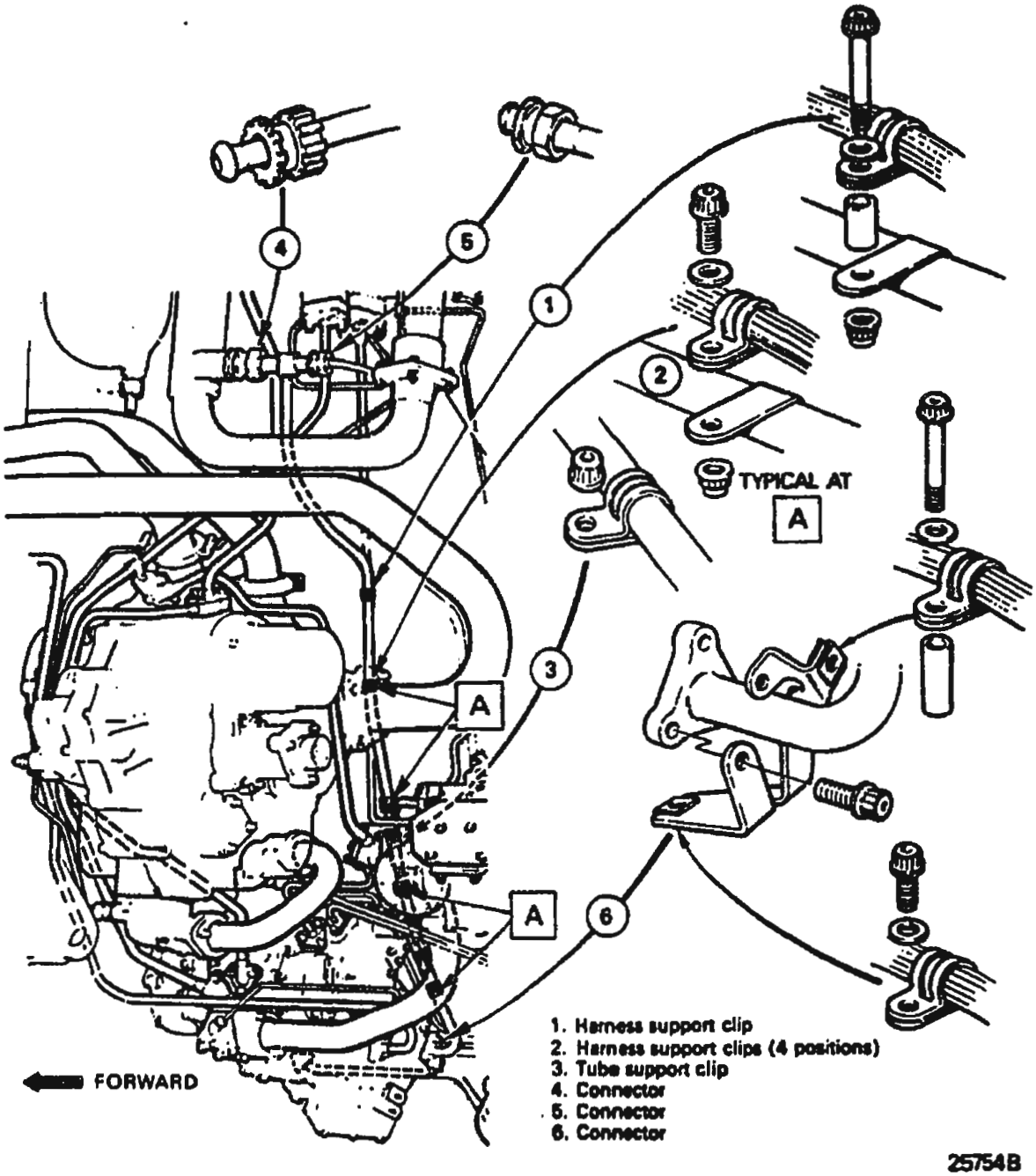
On engines with S.B.73-5160, refer to fig.203 (Sheet 2) disconnect and remove adapter assembly (16), leave harness and tube attached to brackets.

(4) Refer to fig.205, remove bolts (1), then using extractor T.459640 remove cover (2) and then remove gasket (3) and wavy washer (4).

(5) On engines without
Lucas S.B.FFR101-73-48 (Mod.CP.4951)
Using extractor T.466539 withdraw P4 filter (5) from
C housing. If puller pin is installed (Ref.fig.203B)
C rock filter gently with pliers while pulling on
C puller pin

On engines with
Lucas S.B.FFR101-73-48 (Mod.CP.4951).
Using suitable hook ended tool, engage tool hook with P4 filter (5) extraction rib and withdraw filter from housing

(6) Fit blanks to all exposed apertures.



P4 air tube disconnect points - engine without S.B.73-5160
Fig.204

B. Prepare to install P4 filter (Cleaning)

C (1) Equipment required:

C Compressed air supply

C (2) Material required:

	British Spec./Ref.	American Spec./Ref.	OMat Item No.
Ultrasonic cleaning facility	-	-	

C (3) Clean P4 filter in ultrasonic cleaner

C. Install P4 filter

(1) Material required:

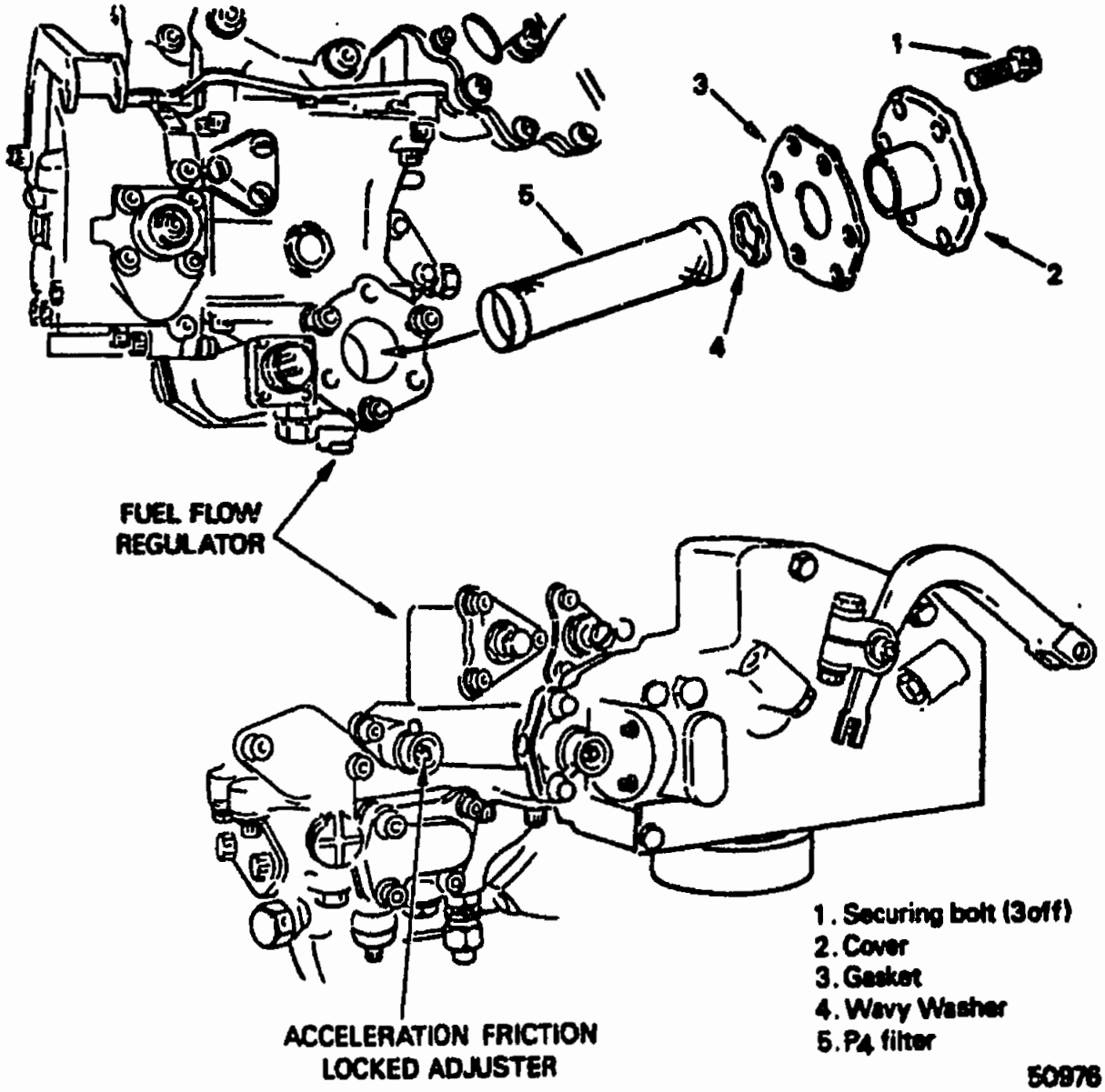
	British Spec./Ref.	American Spec./Ref.	OMat Item No.
Lockwire	DTD.189A 22 S.W.G.	- 21 A.W.G.	238

(2) Remove blanks from all apertures.

(3) Assemble together large P4 filter (5), new wavy washer and cover (2) by pushing filter and washer up to location shoulder machined on inside of cover.

C (4) CAUTION: COVER WILL FIT FLUSH WITH F.F.R. BODY IF FILTER IS CORRECTLY INSTALLED. SECURE WITH BOLTS (1) TORQUE TIGHTEN BOLTS TO 86 LB./IN.
Fit new gasket (3) on cover (2) then fit assembly into housing.

(5) Secure cover (2) with bolts (1). Torque tighten bolts to 86 lb.in. (9.72 Nm.).



P4 filter removal/installation
Fig.205

(6) On engines without S.B.73-5160, refer to fig.204, position P4 tube then connect and secure connector (6) positioning bracket under bolt heads.

(a) Connect and tighten (Ref. 70-51-00) connectors (5) and (4) then wirelock.

(b) Secure P4 tube support clip (3) to L.P. compressor case.

(c) Secure harness support clips (1) and (3) to P4 tube.

(d) Secure harness and tube support clips to bracket at connector (6) positioning tube support clips under spacer and harness support clips on top of spacer.

On engines with S.B.73-5160, refer to fig.203 (Sheet 2), fit and secure adapter assembly (16), ensure brackets are correctly positioned.

(7) Close left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL for engine No.2 (Ref. 71-12-01).

C 4. Removal/Installation P4P Filter (Deleted)

5. Removal/Installation Splitter Assembly

Referenced Procedures

71-11-00 Cowlings, Engines No.1 and No.3 - Servicing
71-12-01 LH and RH Lower Hinged Cowl - Servicing

Illustrated Parts Catalogue References

The I.P.C. sections where parts disturbed during the following operations can be located are as follows:

73-21-01 Fuel Flow Regulator Installation

The following instructions apply only to those parts removed for cleaning and do not give permission for the replacement of any parts other than expendable items, e.g. sealing rings. If other parts require replacement the Fuel Flow Regulator must be changed.

A. Remove Splitter Assembly

(1) Equipment required:

Extractor T485973

(2) Open left-hand hinged cowl 413A or 413A for engines No.1 and 3 (Ref. 71-11-00) or 433AL for engine No.2 (Ref. 71-12-01).

(3) Refer to fig.206, remove bolts (1) and (2).

(4) Remove cover (3), baffle plate (4) and gasket (5).

(5) Using extractor T485973 withdraw orifice plate (6) together with gasket (7).

B. Prepare to Install Splitter Assembly (Cleaning)

(1) Material required:

	British Spec./Ref.	American Spec./Ref.	OMat Item No.
Ardrox 185	DEF STAN 03-2	MIL-C-14460-B	173
or Methyl Ethyl Ketone (M.E.K.)	B.S.1940: 1968	-	135
or Sodium Hydroxide	-	-	106
and Sodium Gluconate	-	-	1/55

NOTE: Sodium Hydroxide and Sodium Gluconate mixed, are equivalent to Ardrox 185

Kerosine	D.Eng.RD2494	-	101

(2) Pressure wash the components using kerosine in an appropriate bath.

(3) Dry using moisture-free compressed air.

(4) Heat a solution of Ardrox 185 (20% WV - Ardrox/water) in a lidded stainless steel container to a temperature of 82 deg.C. to 88 deg.C. (180 deg.F. to 190 deg.F.).

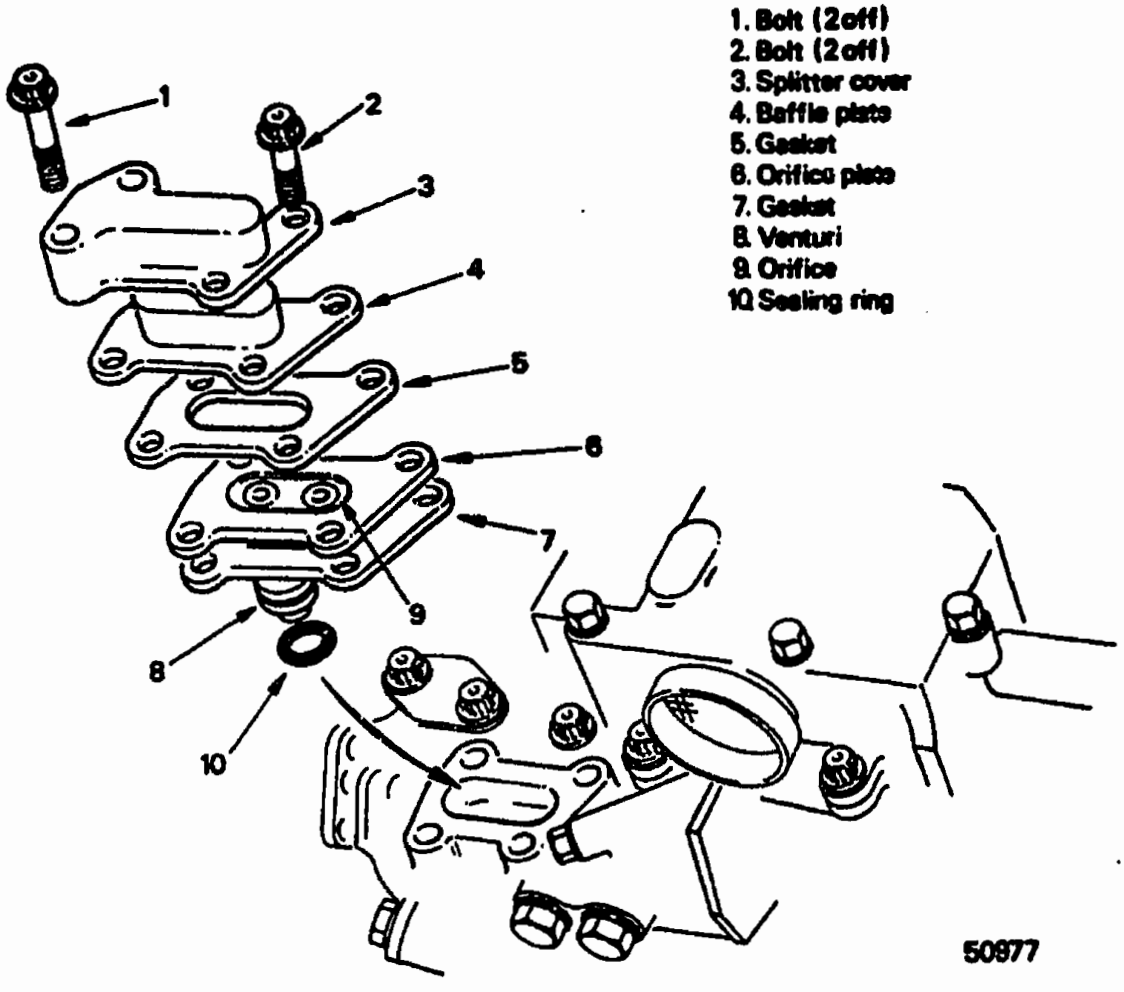
(5) Immerse components in Ardrox solution for 1 hour.

(6) Transfer components to a hot water swill to remove Ardrox solution; remove any adhering material and/or contaminant from joint faces.

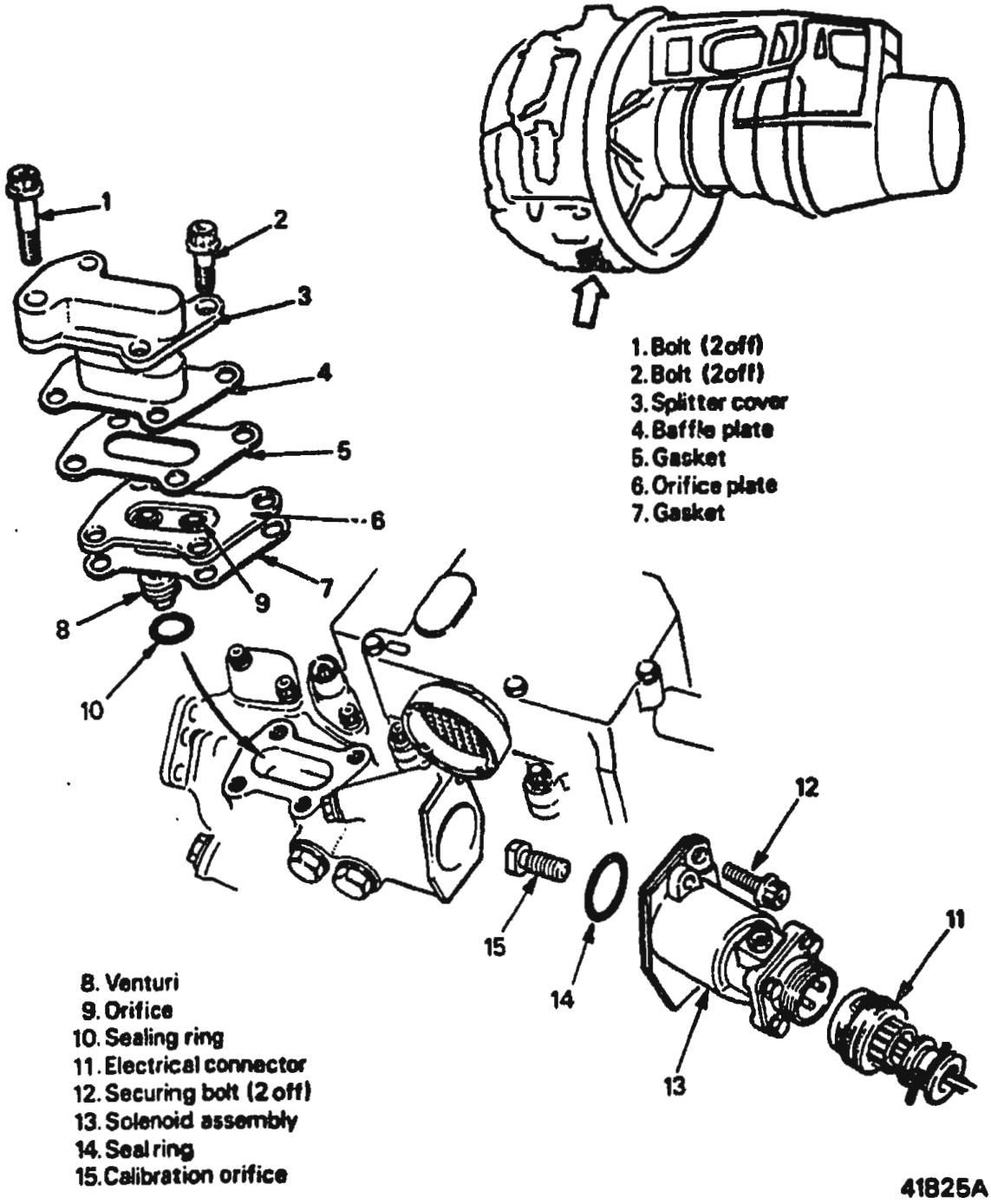
(7) Further wash components in cold running water ensuring all traces of Ardrox solution is removed from threaded areas and that contact faces are clean.

(8) Repeat if necessary, operations (4) through (7) until all traces of contamination are removed.

(9) Dry using moisture free compressed air.



C Splitter assembly without S.B.73-4345
C removal/installation
C Fig.206



1. Bolt (2off)
2. Bolt (2off)
3. Splitter cover
4. Baffle plate
5. Gasket
6. Orifice plate
7. Gasket
8. Venturi
9. Orifice
10. Sealing ring
11. Electrical connector
12. Securing bolt (2 off)
13. Solenoid assembly
14. Seal ring
15. Calibration orifice

Ground idle reset solenoid and splitter assembly engine with S.B.73-4345 removal/installation
Fig.206A

C. Install Splitter Assembly

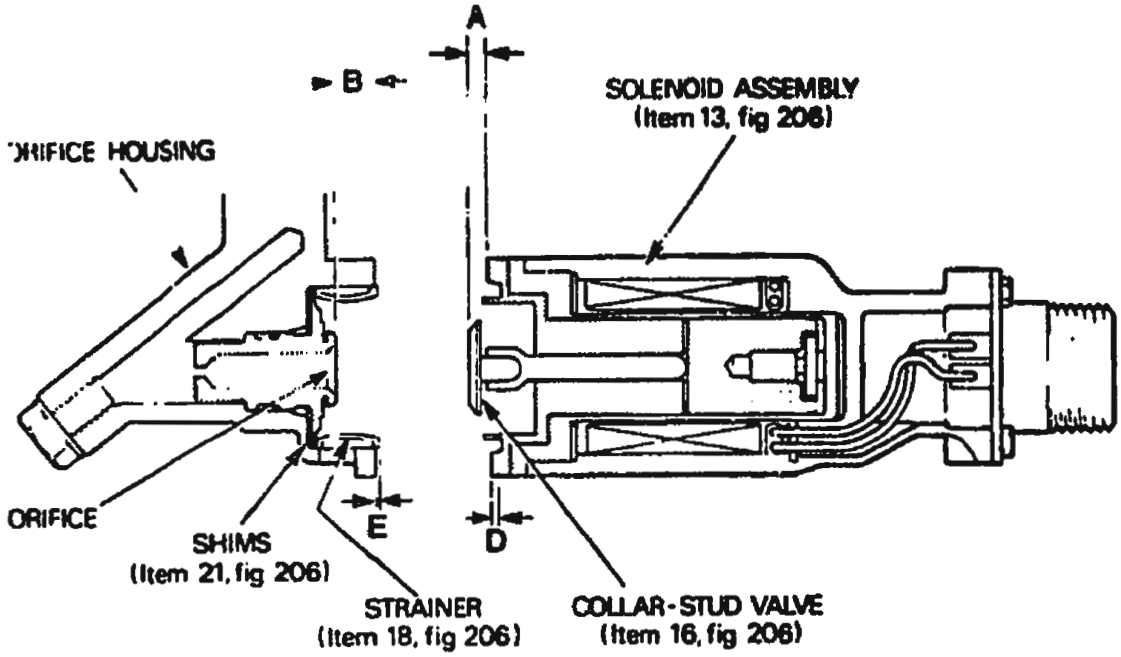
(1) Refer to fig.206, fit a new sealing ring (10) to venturi (8). Do not apply lubricant to sealing ring before nor after fitting.

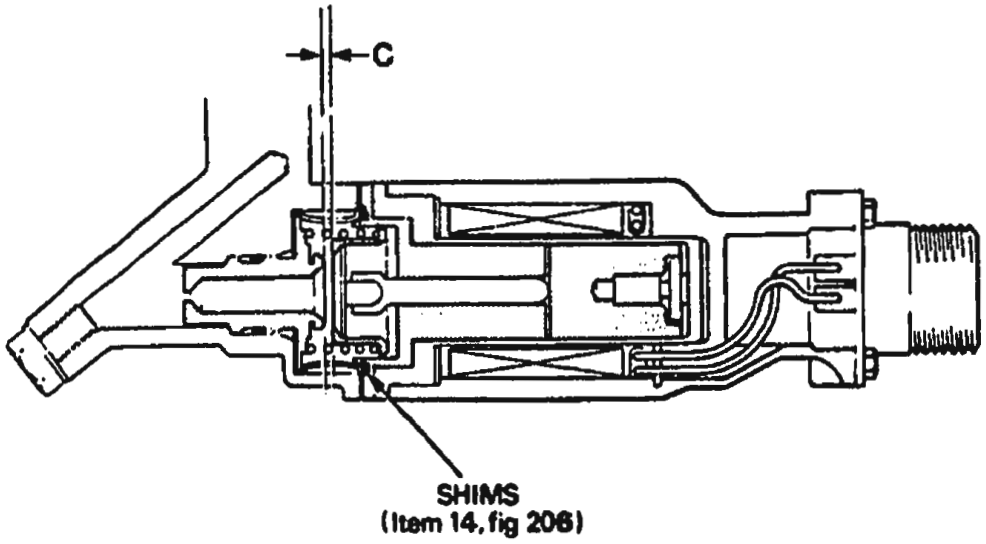
(2) CAUTION: ENSURE CORRECT GASKET IS SELECTED FOR FITMENT.
Fit a new gasket (7) (Pt.No.77116463) on orifice plate (6).

(3) Fit orifice plate (6) together with gasket (7), to splitter housing.

(4) Fit a new gasket (5) (Pt.No.77116462) on baffle plate (4) then fit gasket, baffle plate and cover (3) to orifice plate (6) and secure complete assembly to splitter housing with bolts (2) and (1). Torque tighten bolts to 86 lb.in. (9,72 Nm.).

(5) Close left-hand hinged cowl 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL for engine No.2 (Ref. 71-12-01).





29815B

Solenoid valve setting Pre-Lucas S.B.FFR101-73-66 Mod CP.4758
(R.R. S.B.73-4345)
Fig.207

C 6. Introduction of Recalibrated Fuel Flow Regulator, TWA Stk. Nbr. 29219

A. A change is coming your way due to the introduction of the cast directionally solidified turbine engine.

B. A recalibrated fuel flow regulator is being put in stock at LAX and JFK only. Other stations will be allocated as more engines are converted to the cast directionally solidified turbine configuration. The recalibrated FFR will bear a Lucas P/N FFR 101-Mark 10, and a TWA Stk. Nbr. 29219. The TWA stock number has been painted on the unit in two places - the throttle box cover and the rocker lever and stirrup assembly cover. Both of which are visible with the unit installed. The unit has been recalibrated to provide a schedule that is more suitable for use with the turbine rematch engine which will be introduced along with the cast directionally solidified turbine program.

C. The recalibrated FFR, TWA Stk. Nbr. 29219, can be used on our present engines. A minor adjustment of the Start Control Unit (SCU) enrichment orifice is required. The enrichment orifice must be adjusted fully clockwise to prevent over-fueling during starting and off idle stalling.

D. When the recalibrated FFR, TWA Stk. Nbr. 29219, is used on a cast directionally solidified turbine engine, no adjustments are required. The existing FFR's, TWA Stk. Nbr. 29214, cannot be used on the cast directionally solidified turbine engine.

E. The stock of recalibrated FFR,S, TWA Stk. Nbr. 29219, is obtained by reducing the number of units, TWA Stk. Nbr. 29214, available. No new units will be purchased to accommodate the double stocking required.

C 7. RB211 Fuel Flow Regulator - Air Side Wash Procedure

C A. Throttle stagger continues to be a major cause of premature
C FFR removals. Contamination of the FFR air side by dirty P4
C air causes the fuel schedule to drift rich (as the Adze
C orifice becomes contaminated) causing a 'throttle lagging'
C condition. Likewise, the same dirty air can cause a 'throttle
C leading' condition as the pepper pot becomes contaminated. As
C the fuel schedule drifts, the maximum power adjuster on the
C FFR is adjusted to increase/decrease fuel flow, thereby
C compensating for the effects of contamination. When the
C maximum power adjuster bottoms out preventing further
C adjustment, the FFR is prematurely removed. Coupled with the
C possibility of EPR error, various degrees of contamination
C between engines removals lead to a time consuming, costly
C exercise in replacing FFRs and excessive maintenance costs.
C Procedure has been developed and proven that the contamination
C can be removed and power restored by washing the FFR air side
C on-wing. While the procedure is not complex, it must be
C followed precisely if the expected benefits are to be gained.
C It is important that it be done properly using correct soak
C times, flushing, rinsing, etc., or not attempted.
C Additionally, due to problems identifying the degree of
C contamination, the procedure must be done on all three
C engines. Also, it is not to be attempted unless someone is
C present, who is checked out and familiar with the job.

C B. Wash Procedures

C (1) Materials/Tools Required

C (a) Turco 5884 Cleaner - Two gallons for each FFR

C (b) Alemite Hand Pump/Bucket

C (c) Three one-quart clean metal containers one-third
C full of Turco 5884 Cleaner

C (d) Regulated air source maximum 75 psi

C (e) Wash kit containing all hardware, fittings, plates,
C adapters and splitter removal tool

C (f) Seals and Gaskets

C (i) Gasket, TWA Stk. Nbr. 76-5258, 6 ea.

C (ii) O Ring, TWA Stk. Nbr. 32-5625, 6 ea.

C (iii) Gasket, TWA Stk. Nbr. 76-5257, 3 ea.

C (2) Gain access to all three FFRs.

C (3) Accomplishment routine static rigging of aircraft
C throttle system for all three engines.

C (4) Position the FFR maximum power adjuster on all three
C engines at the datum setting (indicator nut on adjusting
C screw should be flush with bottom of slot), and advance
C all thrust levers to take-off position against the
C forward stop (Ref.Figure 208 (Sheet 2).

C (5) Advance lever to take-off position against forward
C pedestal stop.

C (6) Remove the P4 air line at the FFR interface by removing
C three attach bolts. Remove one short bolt (inboard most
C locations) from P4 tube mount plate. Install the P4
C wash adapter with the fitting pointing down using the
C three removed attach bolts (Ref.Figure 208 Sheet 3).

C (7) Using splitter removal tool from kit, remove splitter
C orifice cover and splitter orifice. Place removed
C splitter orifice and cover into one-quart metal container
C with Turco 5884 and allow to soak during accomplishment
C of air side wash.

C CAUTION: USING BLACK MAGIC MARKER, MARK APPLICABLE ENGINE
C POSITION (1, 2 OR 3) ON METAL CONTAINER TO PREVENT
C MIXING SPLITTER ORIFICES BETWEEN FFRS BEING WASHED
C (REF.FIG.4).

C (8) Install splitter blocking plate from kit using new
C gasket, Stk Nbr. 76-5258, new O-ring, Stk. Nbr.78-1930
C and four short bolts.

C (9) Remove ground idle solenoid cannon plug from FFR.

C (10) Connect alemite pump to P4 wash adapter and fill bucket
C with two gallons of Turco 5884 cleaner.

C (11) Using brisk pumping action, pump cleaner into FFR until it runs overboard out the air throttle valve (pepper pot) screen. Stop flow of cleaner and let unit soak for 30 minutes.

CAUTION: IF CLEANER FLOWS OUT THE HOLE IN THE CENTER OF THE SPLITTER BLOCKING PLATE, O-RING IS EITHER DAMAGED OR MISSING. REMOVE SPLITTER BLOCKING PLATE AND REPLACE O-RING (REF. STEP(8)).

C (12) After 30 minutes, again pump cleaner through FFR until approximately one gallon is left. Stop and again allow another 30 minute soak time.

C (13) After second soak time, continue pumping until remaining cleaner has been pumped through FFR and allow unit to soak for 10 minutes.

C (14) Remove pump from P4 adapter and connect pressurezed (maximum 75 psi) air source to the adapter and flush FFR of cleaner.

C (15) Disconnect air source and connect water source to P4 adapter on FFR. Flush FFR air side with water for approximately five minutes or until entire four gallons are used if using elemite pump.

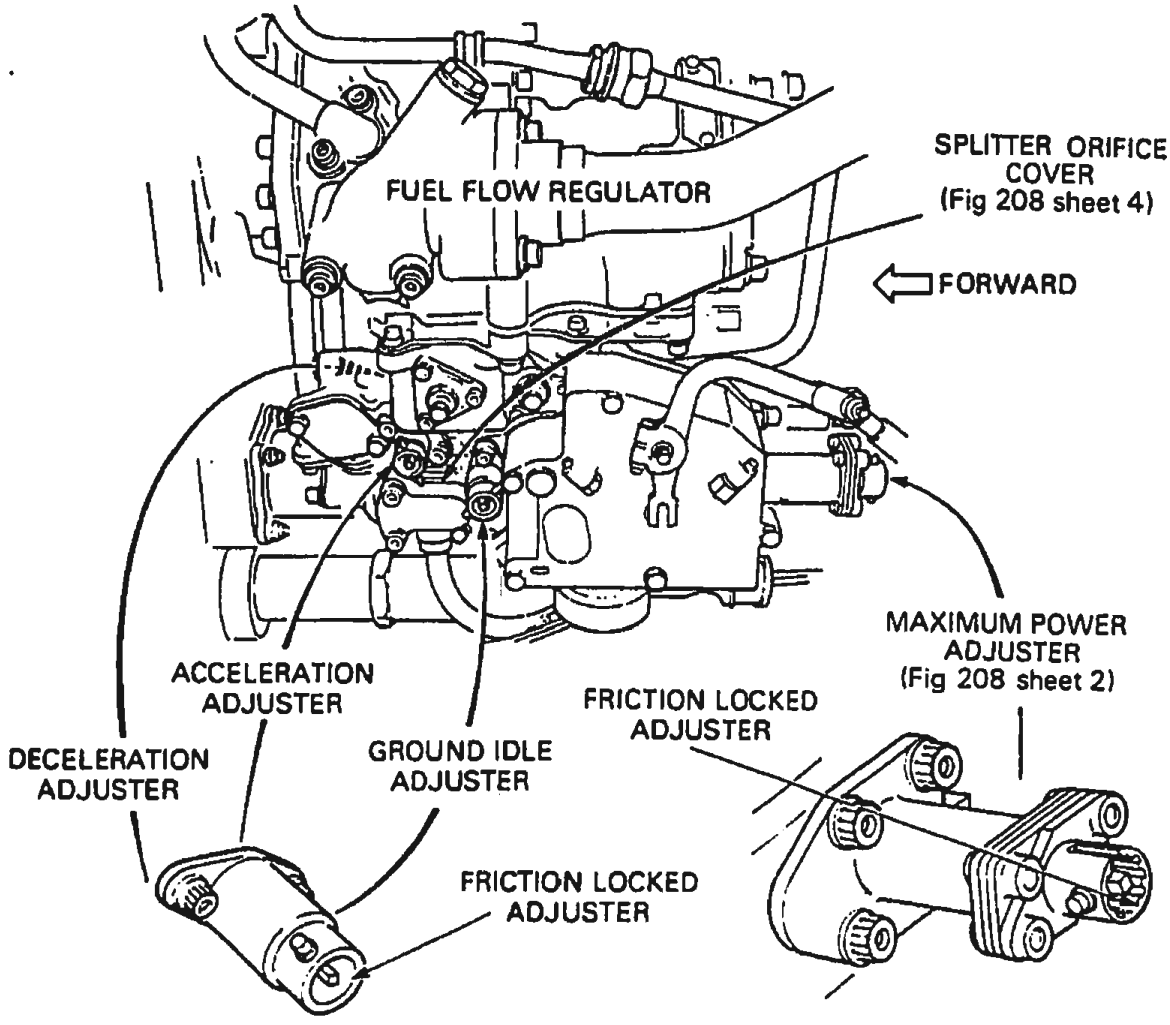
NOTE: If water hose is not available, it is acceptable to clean the alemite pump bucket and fill with four gallons of water to flush FFR.

C (16) Remove water source from P4 wash adapter and again connect pressurized air source (maximum 75 psi) and flow air through FFR air side for approximately five minutes to dry out the unit.

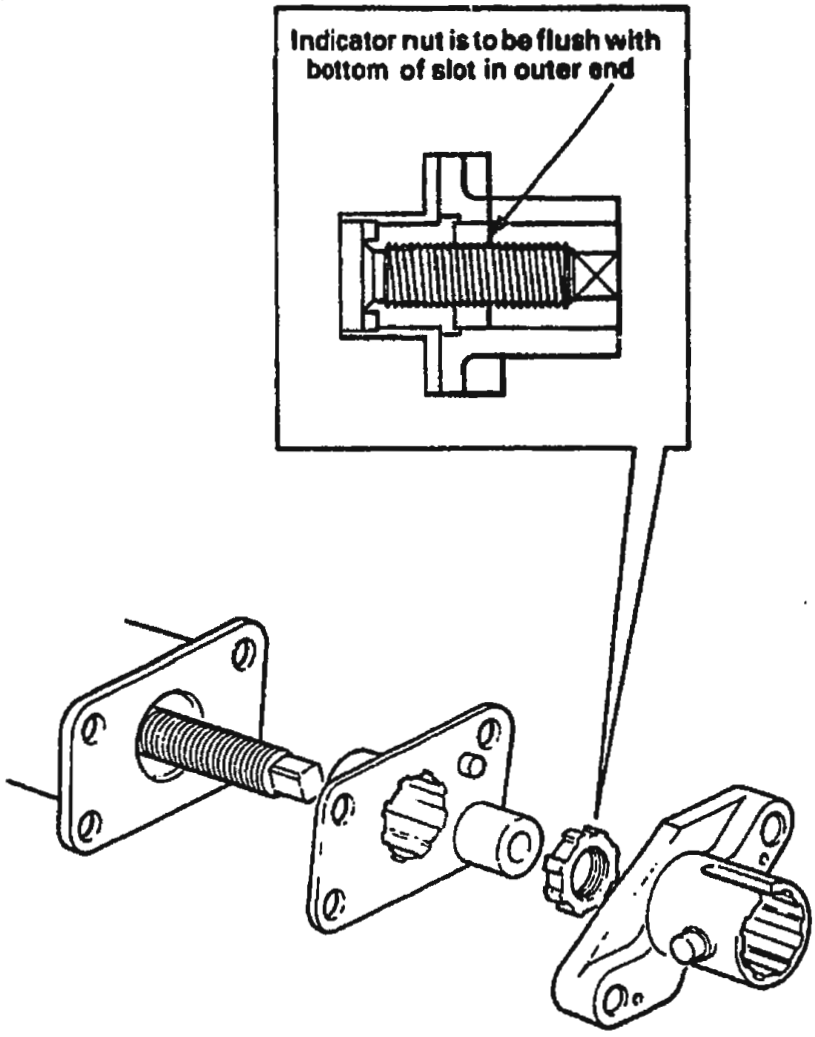
C (17) Remove air source and reinstall P4 air tube to FFR.

C (18) Remove splitter blocking plate from FFR. Remove splitter cover and splitter orifice from Turco 5884. Using clean cloth and pipe cleaner, ensure that splitter orifice and venturi ae clean. Reinstall splitter cover and splitter orifice using new O-ring Stk. Nbr. 32-5425 and new gaskets Stk. Nbr. 72-5257 and Stk. Nbr. 76-5258.

C (19) Reinstall ground idle solenoid cannon plug and retard power lever to idle position.



Fuel Flow Regulator Air Side
Fig.208 (Sheet 1)



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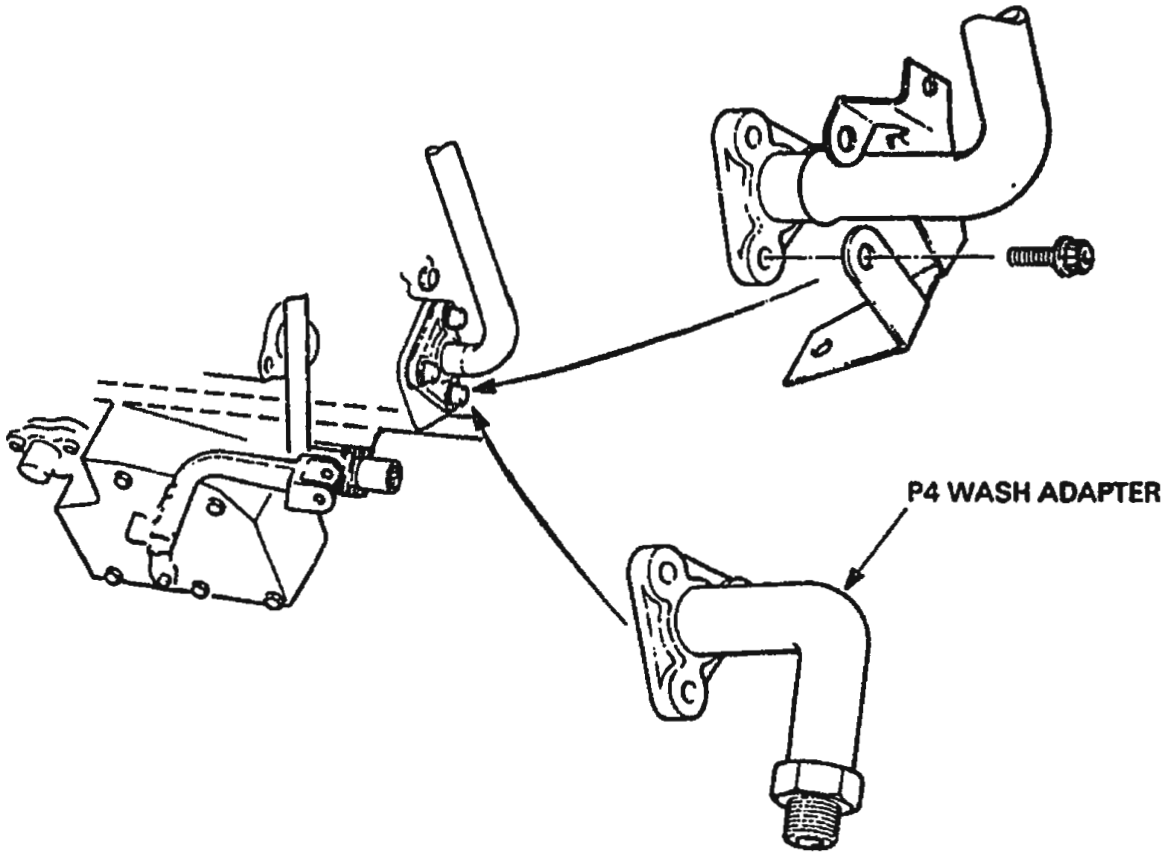
C
C

Maximum Power Adjuster
Fig.208 (Sheet 2)



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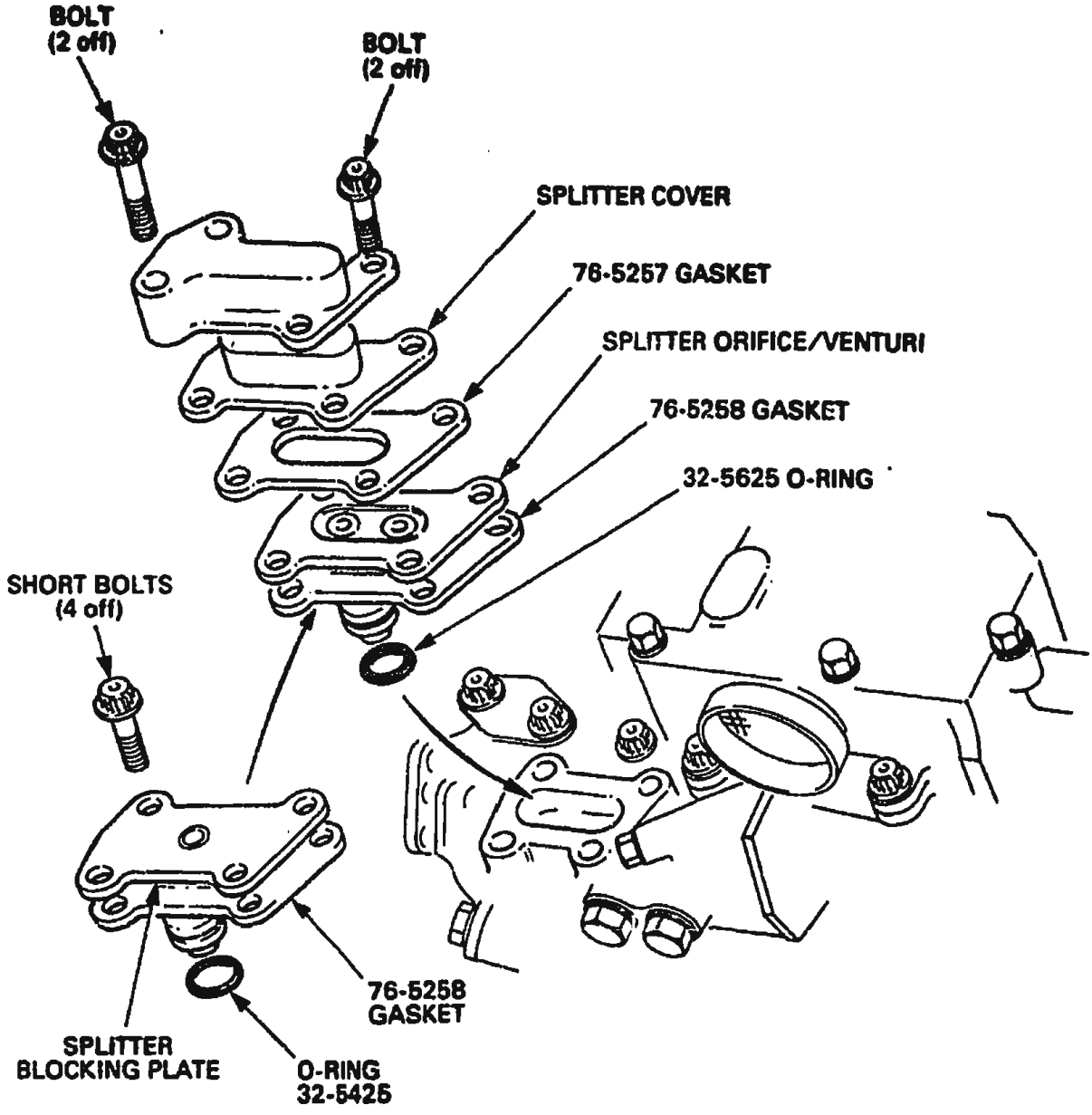
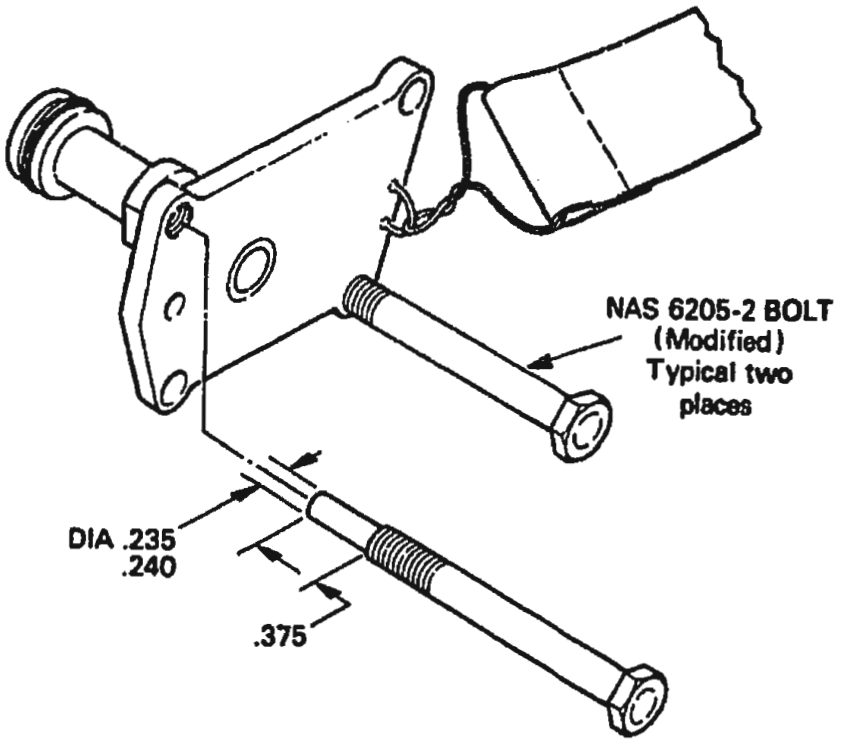
P4 Wash adapter installation
Fig.208 (Sheet 3)



C
C Splitter orifice and cover
Fig.208 (Sheet 4)



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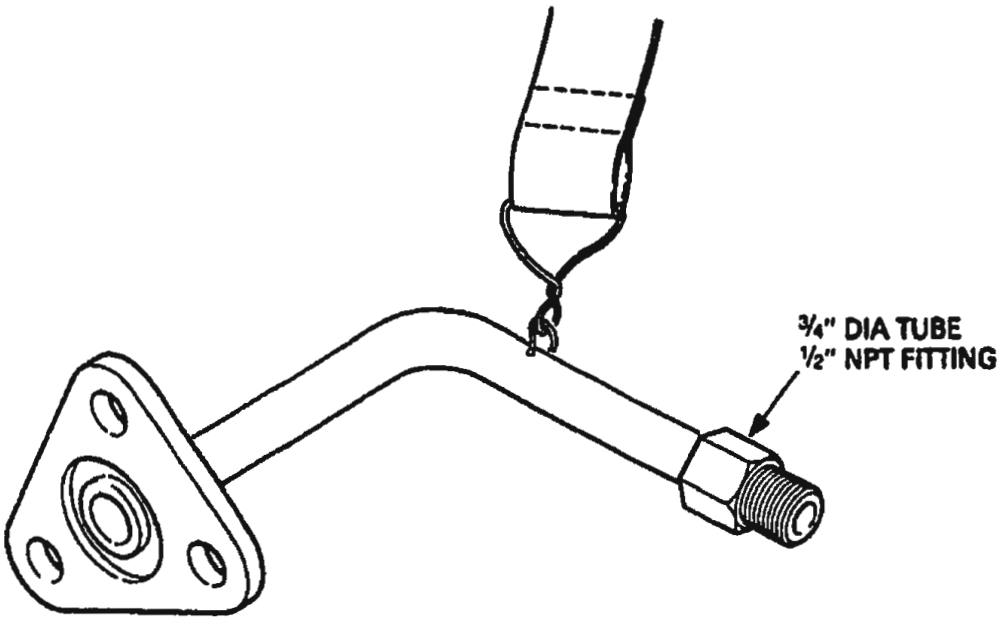
C
C Splitter blocking plate
Fig.208 (Sheet 5)



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C
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P4 Wash adapter
Fig.208 (Sheet 6)

SPEED AND TEMPERATURE CONTROL AMPLIFIER - REMOVAL/INSTALLATION

R 1. General

R A. CAUTION: ENSURE ELECTRICAL CONNECTORS ARE FREE FROM LIQUID AND/OR SOLID CONTAMINATION BEFORE CONNECTING AND DISCONNECTING FAILURE TO DO SO CAN RESULT IN A FIRE.

R The following instructions detail the procedure for the R removal/installation of the Speed and Temperature Control R Amplifier STA103 and the N2 Speed Control Amplifier SCA200.

R B. Service Bulletins referred to:

R Lucas S.B.STA.103-73-1 - Introduction of Speed and Temperature R Control Amplifier STA.103 Mark 1 (R.R.S.B.73-3659). R Lucas S.B.STA.102-73-31 - Amplifier STA.102 reworked to R Amplifier STA.103 Mark 1 Standard. R Lucas S.B.STA.104-73-5 - Amplifier STA.104 reworked to R Amplifier STA.103 Mark 1 Standard. R S.B.71-71-3641 - Engine Light Duty Electrical Harness - R Harness to suit STA.103 Amplifier. R S.B.73-7620 - Introduced Amplifier SCA.200 as an alternative R to Amplifier STA.103.

R C. Referenced Procedures:

R	71-00-00	Power Plant - Adjustment/Test
R	71-11-00	Cowlings, Engines No.1 and 3 - Servicing
R	71-12-05	L.H. and R.H. Upper Hinged Cowl, Engine No.2 - Servicing
R	73-21-00	Engine Fuel Control System - Adjustment/Test

R D. Illustrated Parts Catalogue References:

The I.P.C. sections where parts disturbed during the following operations can be located are as follows:

73-21-02	Speed and Temperature Control Amplifier Installation

R 2. Remove

R A. Open left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433DL for engine No.2 (Ref. 71-12-05).

R B. On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag appropriate FUEL CONT AMP circuit breaker.

R C. On pilots centre console, zone 210, place appropriate Fuel Control Amplifier test switch in OFF position.

R D. On pilots overhead control panel, zone 210, pull appropriate Fire Emergency Shutoff Control.

R E. Refer to fig.401, disconnect electrical connectors (1) and (2).

R F. Remove securing screws and washers (4) and remove T7
R terminal lugs.

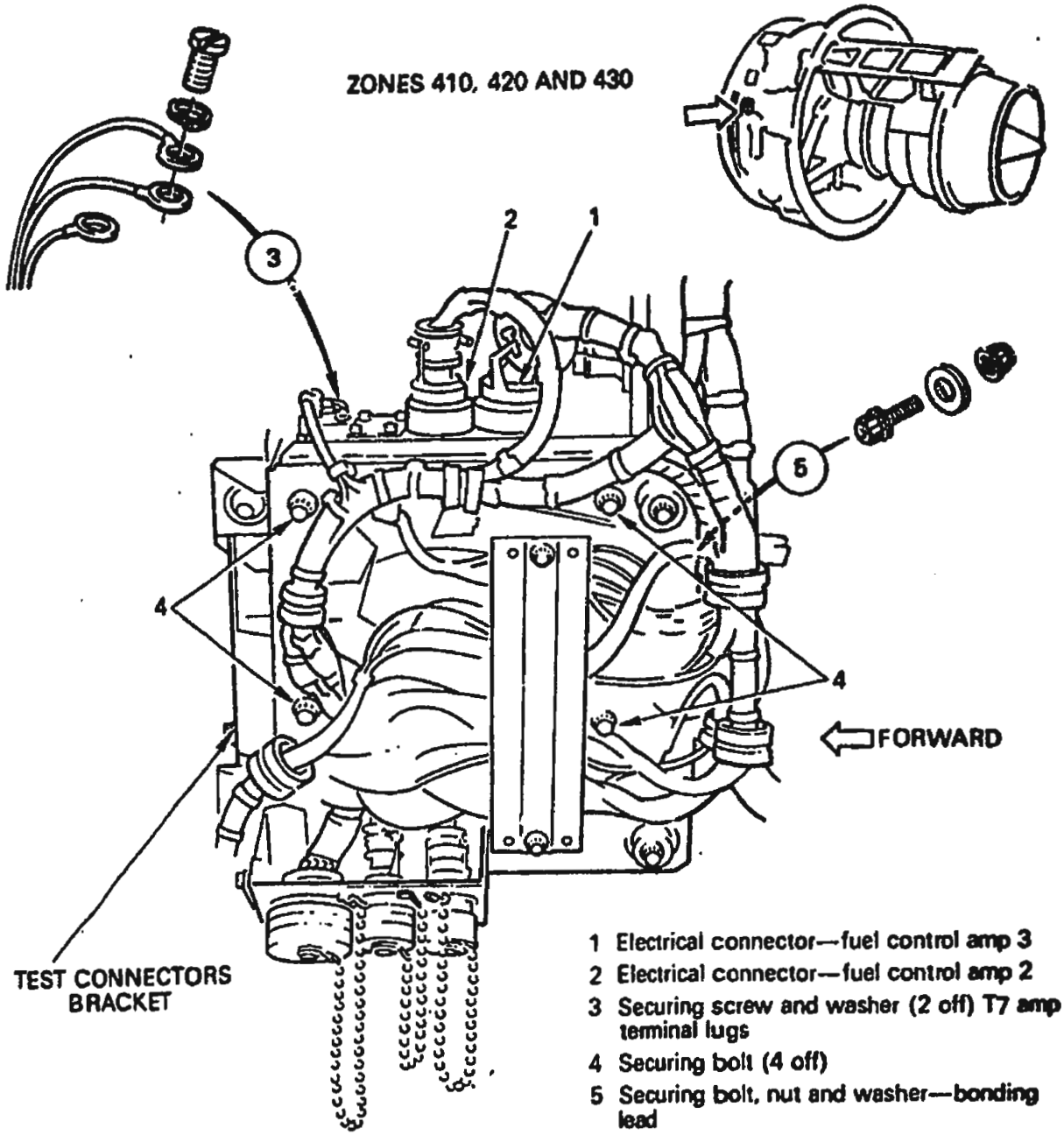
R G. Support amplifier and remove bolts (4).

R H. Remove bolt, nut and washer (5) and withdraw amplifier
R from test connectors bracket; place on clean work surface.

R J. Refer to fig.402, remove bolts (1) and separate amplifier from mounting bracket (2).

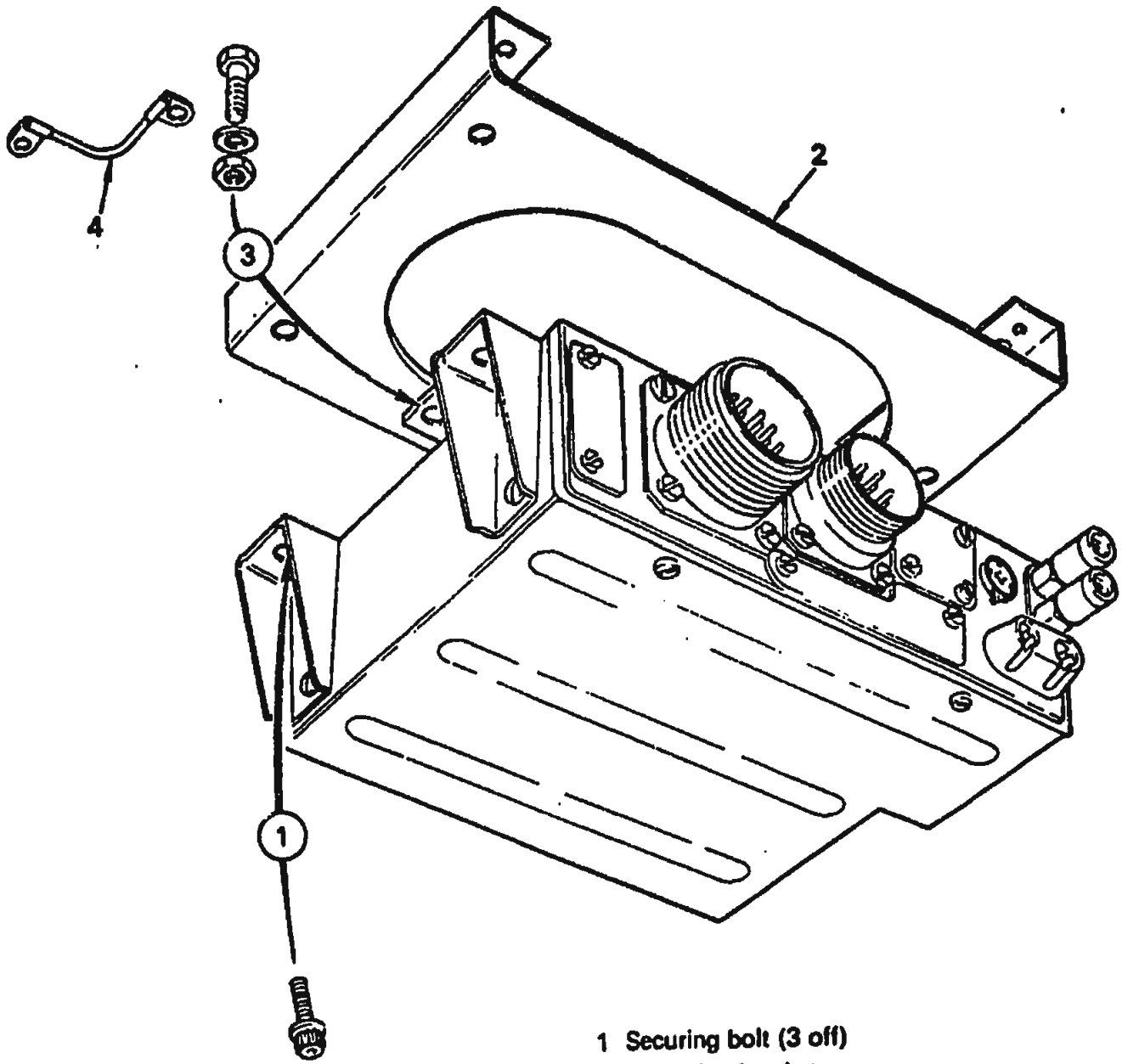
R K. Remove securing bolt, nut and washer (3) and retain bonding lead (4) for fitment to replacement amplifier.

R L. Fit approved blanks to all electrical connectors.



R
R

Amplifier disconnect points
Fig.401



1 Securing bolt (3 off)
2 Mounting bracket
3 Securing bolt, nut and washer
4 Bonding lead

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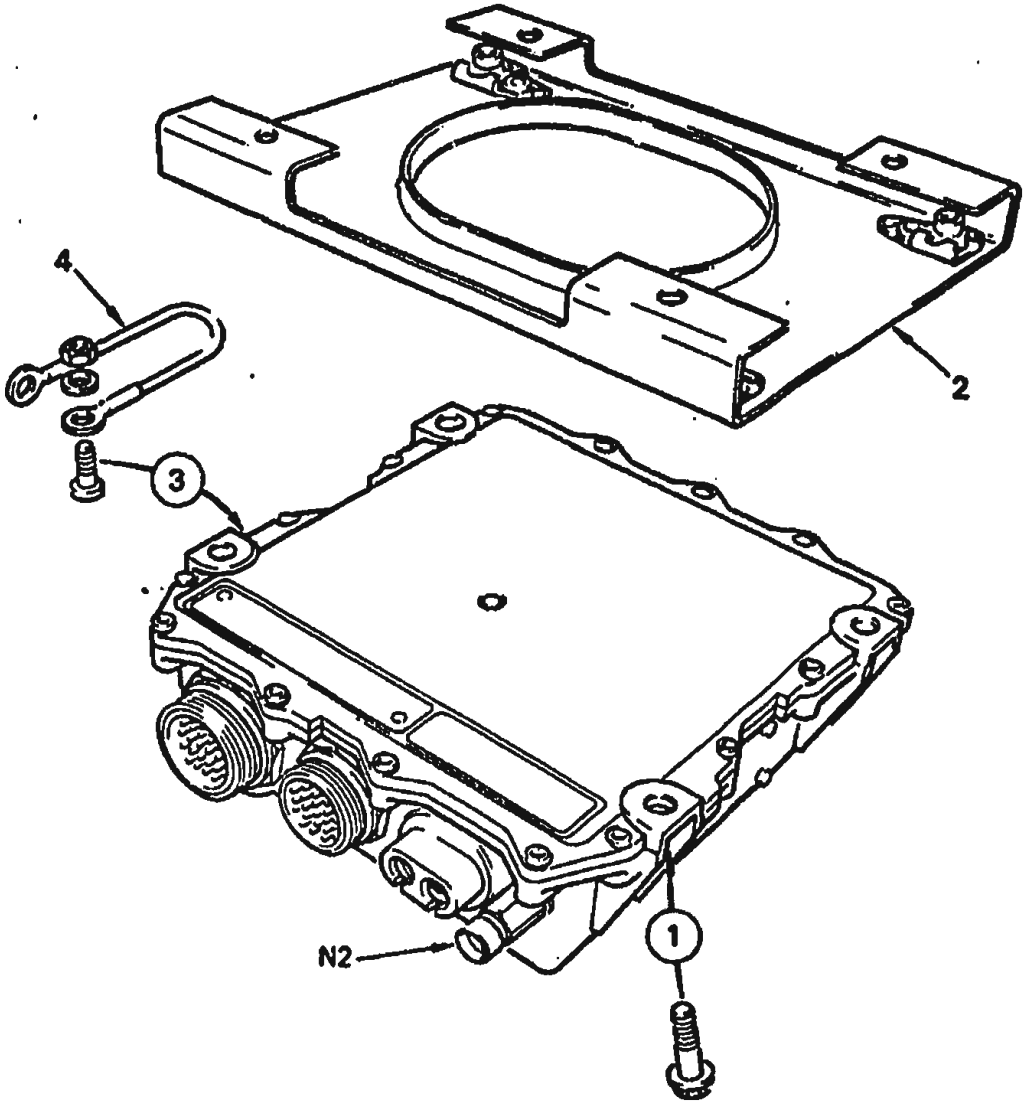
Amplifier STA.103 removal/installation
Fig.402 (Sheet 1)

1 Securing bolt (4 off)
2 Mounting bracket
3 Securing bolt, nut and washer
4 Bonding lead



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R Amplifier SCA.200 removal/installation
R Fig.402 (Sheet 2)

R 3. Install Speed and Temperature Control Amplifier

R A. Ensure appropriate systems are deactivated as detailed in operations 2 A. through (D).

R B. Remove blanks if fitted, from electrical connectors.

R C. Refer to fig.402, position bonding lead (4) on amplifier lug and secure with bolt, nut and washer (3).

R D. Position mounting bracket (2) on amplifier and secure with bolts (1).

R E. Refer to fig.401, enter amplifier into test connectors bracket and secure bonding lead to test connectors brackets with bolt and washer (5).

R F. Align amplifier with test connectors bracket and sure with bolts (4).

R G. Position and secure T7 terminal lugs with screws and washers (5).

R H. Connect and secure electrical connectors (2) and (1).

R J. Reactivate systems deactivated in operations 2.A. through D.

R K. Before next flight, test speed and temperature control amplifier (Ref.73-21-00).

CR NOTE: 1. Test No.8 - Speed and temperature control
C amplifier redatum and override test
C (Ref. 71-00-00, Adjustment/Test) may be used
C as an alternative.

R 2. On engines with STA.103 amplifiers where high
R power running is prohibited or a suitable test
R set is not available Test 18 (Ref.71-00-00)
R can be used as an alternative.

R L. Close left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433DL for engine No.2 (Ref.71-12-05).

STARTING FUEL FLOW REGULATOR - MAINTENANCE PRACTICES

1. Removal/Installation Starting Fuel Flow Regulator

Service bulletins referred to:

S.B.73-4592 - Increased cold day enrichment fuel flow

R S.B.73-5818 - Fitment of SCU101 MK6 or MK7 in lieu or MK11

R CAUTION: S.B.73-5818 MAY OBLY BE INCORPORATED ON ENGINES
R INCORPORATING S.B.73-4592

Referenced Procedures:

12-11-00	Fuel Tank Replenishing
24-41-00	External Power/Ground Service System
70-02-01	Identification, Lubrication and Fitting of Rubber Sealing Rings
71-00-00	Power Plant - Trouble Shooting
71-11-00	Cowlings, Engine No.1 and No.3 - Servicing
71-12-01	L.H. Lower Hinged Cowl - Servicing
71-12-05	L.H. Upper Hinged Cowl - Servicing
73-11-09	Fuel Tubes - Maintenance Practices

Illustrated Parts Catalogue References

The I.P.C. sections where parts disturbed during the following operations can be located are as follows:

71-70-02	Engine Drain Tubes
73-11-09	Fuel System Tubes
73-21-03	Engine Starting Fuel Flow Regulator Installation

A. Remove Starting Fuel Flow Regulator - Engines not incorporating S.B.73-4592

(1) Equipment required:

Clean receptacle - minimum capacity:

5 U.S. gallons
4 Imperial gallons
18 Litres

(2) On pilots overhead circuit breaker panel CBI, Zone 210, open and tag appropriate H.P.3 BLEED AIR circuit breaker.

(3) Open left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL (Ref. 71-12-01) and 433DL (Ref. 71-12-05) for engine No.2.

(4) CAUTION: ENSURE ELECTRICAL CONNECTOR IS FREE FROM LIQUID AND/OR SOLID CONTAMINATION BEFORE DISCONNECTING. FAILURE TO DO SO COULD RESULT IN A FIRE.
Refer to fig.201 (Sheet 1), disconnect electrical connector (1).

(5) Disconnect connectors (3), (7) and (9). Leave brackets connected to harness and tube support clips.

(6) Refer fig.201 (Sheet 2), remove tube (5).

(7) Disconnect connectors (13) and (17).

(8) Remove bolts and washers (19) and remove regulator from support bracket.

(9) Fit approved blanks to all exposed apertures and connectors.

(10) Inhibit regulator as described in 1.B.

B. Inhibit Starting Fuel Flow Regulator

Inhibiting can be delayed for up to 48 hours, providing all connectors and apertures are suitably blanked.

The connection identifications given below refer to those marked on the unit.

(1) Equipment required:

Fluid container, fitted with fine mesh (5 micron) filter.

(2) Material required:

	British Spec./Ref.	American Spec./Ref.	OMat Item No.
Inhibiting fluid	D.T.D.5578 or D.Eng.R.D.2490	MIL-L-7870A or MIL-L-6081C ASG (grade 1010)	1029 1024A
White spirit or Stoddard Solvent	BS.245		102
Waterproof Tape		ASTM D.484-52	1/5

(3) Drain all fuel from regulator.

(4) Using waterproof tape, mask off Po vent and apertures in body assembly.

(5) Fit approved gasket and cover to the burner connector.

(6) Slowly pour inhibiting oil into the D/S SOC connector until the chamber is full then fit gasket and cover to connector.

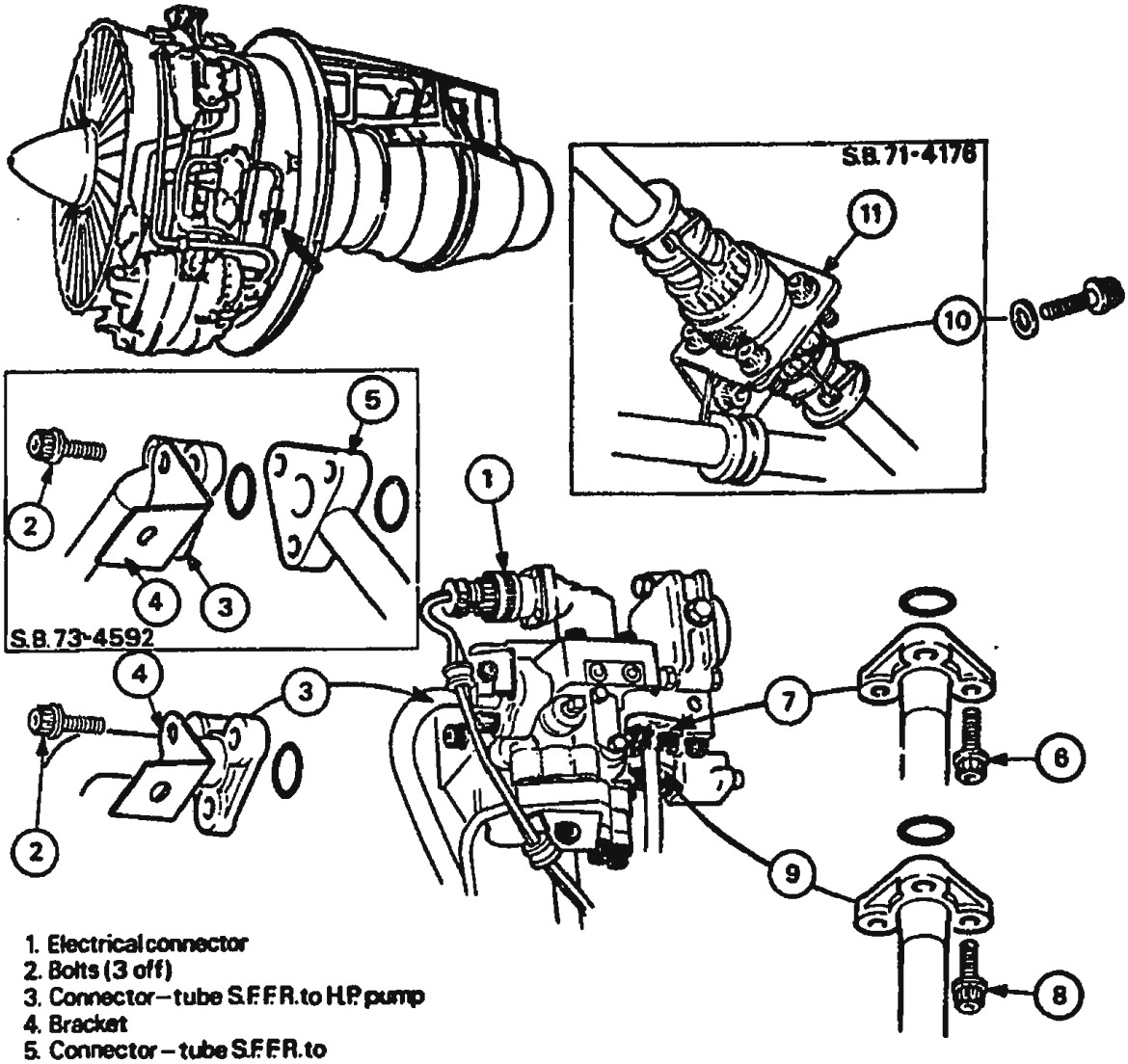
NOTE: The oil container must be fitted with a fine mesh filter (5 micron) to prevent the entry of foreign matter into the unit.

(7) Fill remaining three fuel connectors, the U/S VMO, D/S VMO and DRAIN connectors in turn then fit gaskets and covers.

(8) Clean and dry exterior of unit.

(9) Leave unit for 30 minutes then examine each cover for signs of leakage. Renew any defective gaskets, topping up fluid level as required. Repeat this operation until no leakage is apparent.

(10) Attach label to regulator, recording date and details of inhibiting.



1. Electrical connector
2. Bolts (3 off)
3. Connector – tube S.F.F.R. to H.P. pump
4. Bracket
5. Connector – tube S.F.F.R. to fuel enrich valve
6. Bolt (3 off)
7. Connector – tube S.F.F.R. to H.P. pump outlet
8. Bolt (3 off)
9. Connector – drain tube
10. Bolt and washer
11. Bracket – electrical connector

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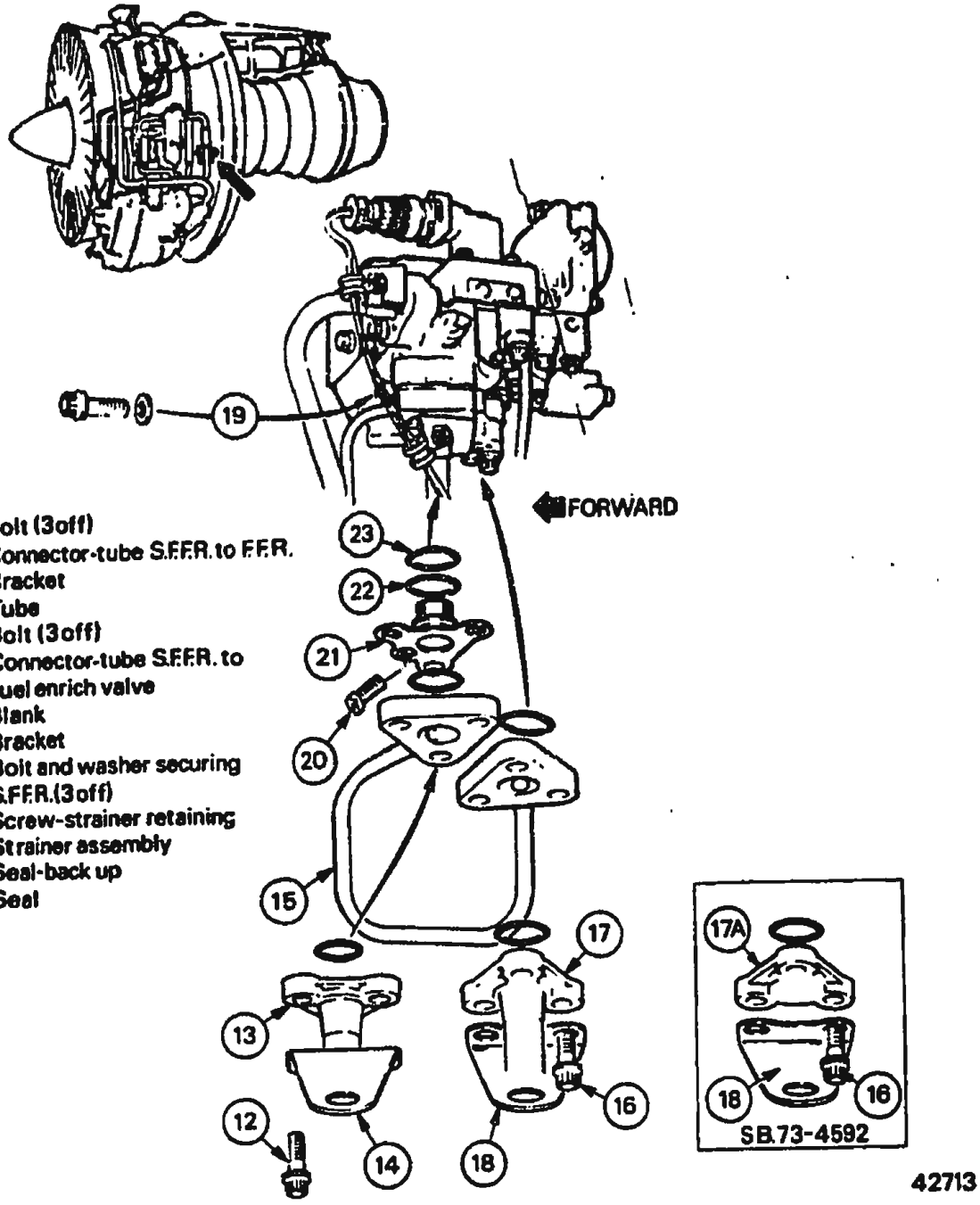
R Starting fuel flow regulator disconnect points
R Fig.201 (Sheet 1)



12. Bolt (3off)
13. Connector-tube S.F.F.R. to F.F.R.
14. Bracket
15. Tube
16. Bolt (3off)
17. Connector-tube S.F.F.R. to fuel enrich valve
17A. Blank
18. Bracket
19. Bolt and washer securing S.F.F.R. (3off)
20. Screw-strainer retaining
21. Strainer assembly
22. Seal-back up
23. Seal

R Starting fuel flow regulator disconnect points
R Fig.201 (Sheet 2)

C. Install Starting Fuel Flow Regulator - Engines not incorporating S.B.73-4592

Refer to 73-11-09 for correct procedure for fitting fuel tubes.

CAUTION: STARTING FUEL FLOW REGULATOR SCU-MK11 (LUCAS MOD. CP.5257) MUST ONLY BE FITTED TO ENGINES INCORPORATING S.B.71-4176 (GENERAL SERVICES LOOM ASSEMBLY MODIFIED TO SUIT FUEL FLOW REGULATOR CALIBRATION V) AND S.B.72-3722 (INCREASED CAPACITY H.P. TURBINE).

(1) Equipment required:

Clean receptacle - minimum capacity

0.5 U.S. gallons
0.5 Imperial gallons
2 Litres

(2) Material required:

Clean engine fuel (Ref. 12-11-00)

(3) Ensure appropriate systems are tagged as detailed in operations A.(2).

(4) Remove transportation covers and gaskets from fuel apertures, and drain off inhibiting fluid.

(5) Flush fuel apertures thoroughly with clean engine fuel.

(6) Remove blank from electrical connector and waterproof tape from Po vent and body assembly.

(7) Refer to fig.201 (Sheet 1), fit and lubricate (Ref. 70-02-01) new seal rings to all tube end connectors and adapters.

(8) Locate regulator on support bracket and secure with bolts and washers (19).

(9) Connect and secure connectors (7) and (9).

(10) Refer to fig.201 (Sheet 2), fit tube (15) to regulator then connect and secure connectors (13) and (17) positioning support brackets under relevant bolt heads.

R (11) Connect and secure connector (3) positioning support bracket under relevant bolt heads.

(12) CAUTION: ENSURE ELECTRICAL CONNECTOR IS FREE FROM LIQUID AND/OR SOLID CONTAMINATION BEFORE CONNECTING. FAILURE TO DO SO COULD RESULT IN A FIRE.
Connect and secure electrical connector (1).

(13) Remove tags and close circuit breaker opened in operation A. (2).

(14) Close left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL (Ref. 71-12-01) and 433DL (Ref. 71-12-05) for engine No.2.

D. Remove Starting Fuel Flow Regulator - Engines incorporating S.B.73-4592

(1) Equipment required:

Clean receptacle - minimum capacity:

5 U.S. gallons
4 Imperial gallons
18 Litres

(2) On pilots overhead circuit breaker panel CBI, Zone 210, open and tag appropriate H.P.3 BLEED AIR circuit breaker.

(3) Open left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL (Ref. 71-12-01) and 433DL (Ref. 71-12-05) for engine No.2.

(4) CAUTION: ENSURE ELECTRICAL CONNECTOR IS FREE FROM LIQUID AND/OR SOLID CONTAMINATION BEFORE DISCONNECTING.
Refer to fig.201 (Sheet 1), disconnect electrical connector (1).

(5) Disconnect connector (3). Leave brackets connected to harness and tube support clips.

(6) Refer fig.201 (Sheet 2), remove blank (17A) disconnect connector (13) then remove tube (15).

(7) Disconnect connectors (7) and (9).

(13) Remove bolts and washers (13) and remove regulator from support bracket.

(9) Fit approved blanks to all exposed apertures and connectors.

(10) *Inhibit regulator as described in 1.B.*

E. Install Starting Fuel Flow Regulator - Engine incorporating S.B.73-4592

Refer to 73-11-09 for correct procedure for fitting fuel tubes.

CAUTION: STARTING FUEL FLOW REGULATOR SCU-MK11 (LUCAS MOD. CP.5257) MUST ONLY BE FITTED TO ENGINES INCORPORATING S.B.71-4176 (GENERAL SERVICES LOOM ASSEMBLY MODIFIED TO SUIT FUEL FLOW REGULATOR CALIBRATION V) AND S.B.72-3722 (INCREASED CAPACITY H.P. TURBINE).

(1) Equipment required:

Clean receptacle - minimum capacity

0.5 U.S. gallons
0.5 Imperial gallons
2 Litres

(2) Material required:

Clean engine fuel (Ref. 12-11-00)

(3) Ensure appropriate systems are tagged as detailed in operations A.(2).

(4) Remove transportation covers and gaskets from fuel apertures, and drain off inhibiting fluid.

(5) Flush fuel apertures thoroughly with clean engine fuel.

(6) Remove blank from electrical connector and waterproof tape from Po vent and body assembly.

(7) Refer to fig.201 (Sheet 2), fit and lubricate (Ref. 70-02-01) new seal rings to all tube end connectors and adapters.

(8) Locate regulator on support bracket and secure with bolts and washers (19).

(9) Connect and secure connectors (7) and (9).

(10) Fit tube (15) to regulator then connect and secure connector (13) and blank (17A) positioning support brackets under relevant bolt heads.

(11) Refer fig.201 (Sheet 1), connect and secure connector (3) ensuring connector (5) is correctly located, and support bracket is positioned under relevant bolt heads.

(12) CAUTION: ENSURE ELECTRICAL CONNECTOR IS FREE FROM LIQUID AND/OR SOLID CONTAMINATION BEFORE CONNECTING.
Connect and secure electrical connector (1).

(13) Remove tags and close circuit breaker opened in operation A. (2).

(14) Close left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL (Ref. 71-12-01) and 433DL (Ref. 71-12-05) for engine No.2.

2. Removal/Installation Starting Fuel Flow Regulator Strainer Assembly

Referenced Procedures:

70-02-01	Identification, Lubrication and Fitting of Rubber Sealing Rings
71-11-00	Cowlings, Engine No.1 and No.3 - Servicing
71-12-01	L.H. Lower Hinged Cowl - Servicing
71-12-05	L.H. Upper Hinged Cowl - Servicing

Illustrated Parts Catalogue References

The I.P.C. sections where parts disturbed during the following operations can be located are as follows:

73-11-09	Fuel System Tubes
73-21-03	Engine Starting Fuel Flow Regulator Installation

A. Remove Strainer assembly

(1) Equipment required:

T.450093 Extractor

(2) On pilots' overhead circuit breaker panel CB.1 zone 210, open and tag appropriate H.P.3 BLEED AIR circuit breaker.

(3) Open left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL (Ref. 71-12-01) and 433DL (Ref. 71-12-05) for engine No.2

(4) Refer to fig.202, remove bolt (6) and bolt, washer and spacer (5) securing tube (4) support clips. Leave clips attached to tubes.

(5) On engines not incorporating S.B.73-4592, remove bolt, washer and nut (10) securing tube (8) support clip. Leave clip attached to tube.

(6) Remove bolts (1) securing tube (4) and brackets (2) and (3). Leave brackets attached to support clips.

(7) Refer fig.201 (Sheet 2), remove bolts (12) securing tube (15), connector (13) and bracket (14). Leave bracket and clip attached to electrical cable.

(8) On engines not incorporating S.B.73-4592, remove bolts (16) securing tube (15), connector (17) and bracket (18). Leave bracket and clip attached to tube.

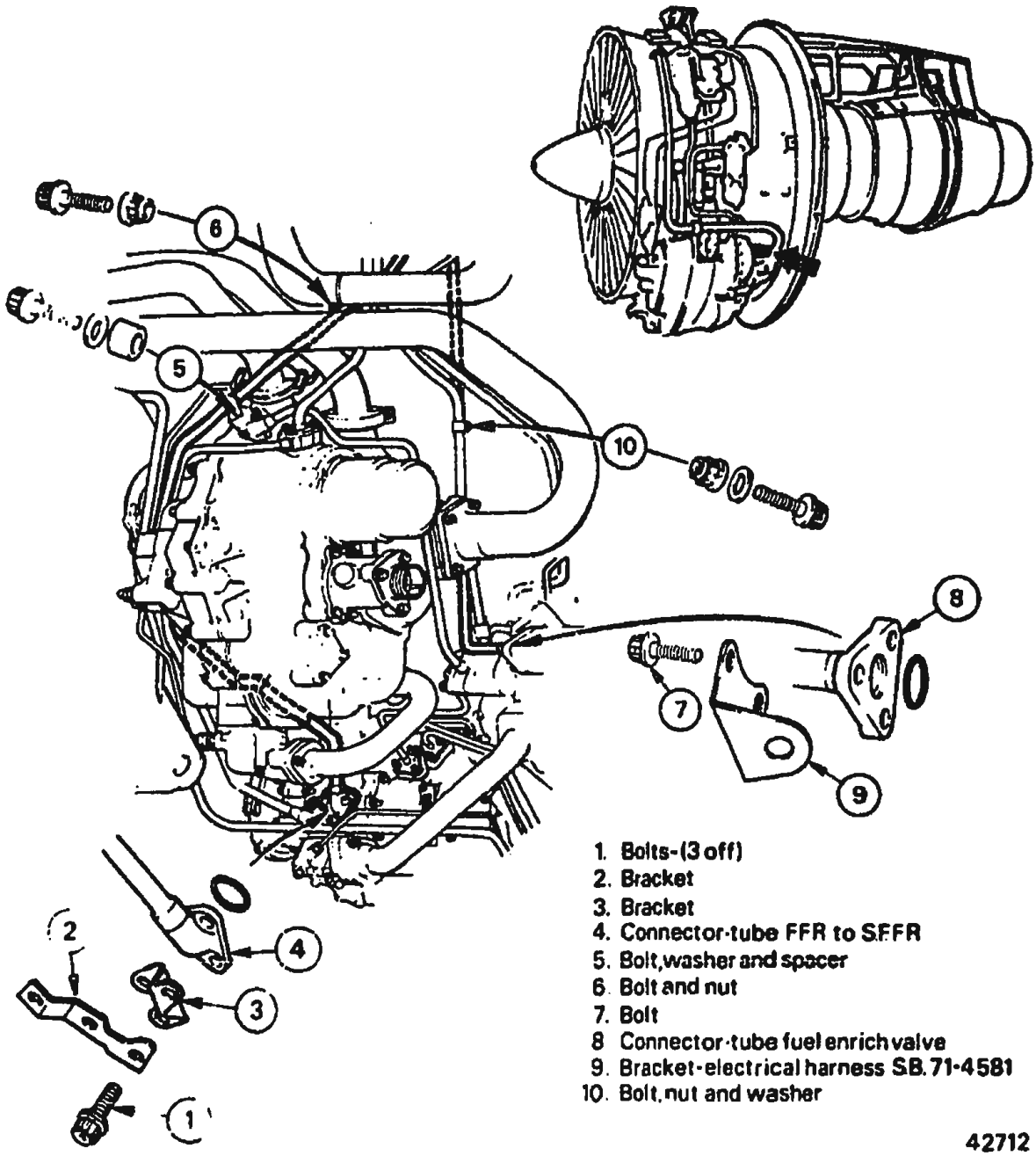
(9) On engines not incorporating S.B.73-4592, refer fig.202, remove bolts (7) securing connector (8).

(10) Refer fig.201 (Sheet 2), move connector (17) sufficiently to allow tube (15) to be removed.

(11) On engines incorporating S.B.73-4592, refer to fig.201 (Sheet 2), remove blank (17A).

(12) Refer to fig.201 (Sheet 2), remove tube (15); move connector (13) sufficiently to gain access to strainer assembly (21).

(13) Remove countersunk screw (20).



1. Bolts-(3 off)
2. Bracket
3. Bracket
4. Connector-tube FFR to SFFR
5. Bolt, washer and spacer
6. Bolt and nut
7. Bolt
8. Connector-tube fuel enrich valve
9. Bracket-electrical harness SB.71-4581
10. Bolt, nut and washer

42712

R Starting fuel flow regulator strainer assembly
R Fig.202

(14) Using extractor, withdraw strainer assembly (21) from body of regulator; remove strainer assembly, complete with sealing ring (23) and back-up ring (22), from extractor.

(15) Remove and discard seals (23) and (22).

(16) Fit blanks to exposed apertures and connectors.

2. B. Prepare to Install Strainer Assembly (Cleaning)

CAUTION: DO NOT USE BRUSHES OR ABRASIVES FOR CLEANING PURPOSES.

(1) Equipment required:

Compressed air supply

(2) Material required:

	British Spec./Ref.	American Spec./Ref.	OMat Item No.
Degreasing fluid (Inhibited and stabilized 1.1.1 trichloroethane)	BS.4487: 1969	MIL-T-81533	1/21

(3) WARNING: WHEN USING DEGREASING FLUID ENSURE ADEQUATE VENTILATION AND AVOID SKIN CONTACT AND INHALING THE VAPOUR.

Clean strainer, using ultra-sonic cleaning bath containing degreasing fluid.

If ultra-sonic cleaning facility is not available other methods are acceptable but cleaning will take longer.

(4) Remove strainer from fluid and thoroughly dry using moisture free air blast.

C. Install Strainer Assembly

Refer to 73-11-09 for correct procedure for fitting fuel tubes.

(1) Material required:

	British Spec./Ref.	American Spec./Ref.	OMat Item No.
Liquid Paraffin B.P.	-	-	1020

(2) Remove blanks from all apertures and connectors.

(3) Lubricate new seal rings and fit them to all tube connectors (Ref.70-02-01).

(4) Refer to fig.201 (Sheet 2), apply liquid paraffin to strainer assembly (21) seal grooves and approach areas. Allow excess fluid to drain off, then fit seal ring (23) and back-up ring (22) to strainer assembly, ensuring that (unchamfered) face of back-up ring abuts seal ring.

(5) Enter strainer assembly into regulator housing bore, align both holes and ease the strainer fully home; secure assembly with countersunk screw (20).

(6) Install tube (15) and position to regulator; position tube (13) bracket (14) and secure with bolts (12).

(7) On engines not incorporating S.B.73-4592, position connector (17) and secure tube (15), and bracket (18) with bolts (16).

(8) On engines incorporating S.B.73-4592, refer to fig.201 (Sheet 2), fit and secure blank (17A).

(9) On engines not incorporating S.B.73-4592, refer to fig.202, secure bracket (9) and lower connector (8) with bolts (7).

(10) Secure tube lower connector (4) and brackets (2) and (3) with bolts (1).

(11) On engines not incorporating S.B.73-4592, refer fig.201 (Sheet 2) fit connector (17) and bracket (18).

(12) Refer fig.202, fit support clip with bolt, nut and washer (10).

(13) Secure tube (4) support clip with bolt (6).

(14) Secure tube (4) support clip with bolt, spacer and washer (5). Interpose spacer between tube support clips.

(15) Close H.P.3 BLEED AIR circuit breaker.

(16) Close left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL (Ref. 71-12-01) and 433DL (Ref. 71-12-05) for engine No.2.

3. Adjustment/Test Starting Fuel Flow Regulator

Service Bulletins referred to:

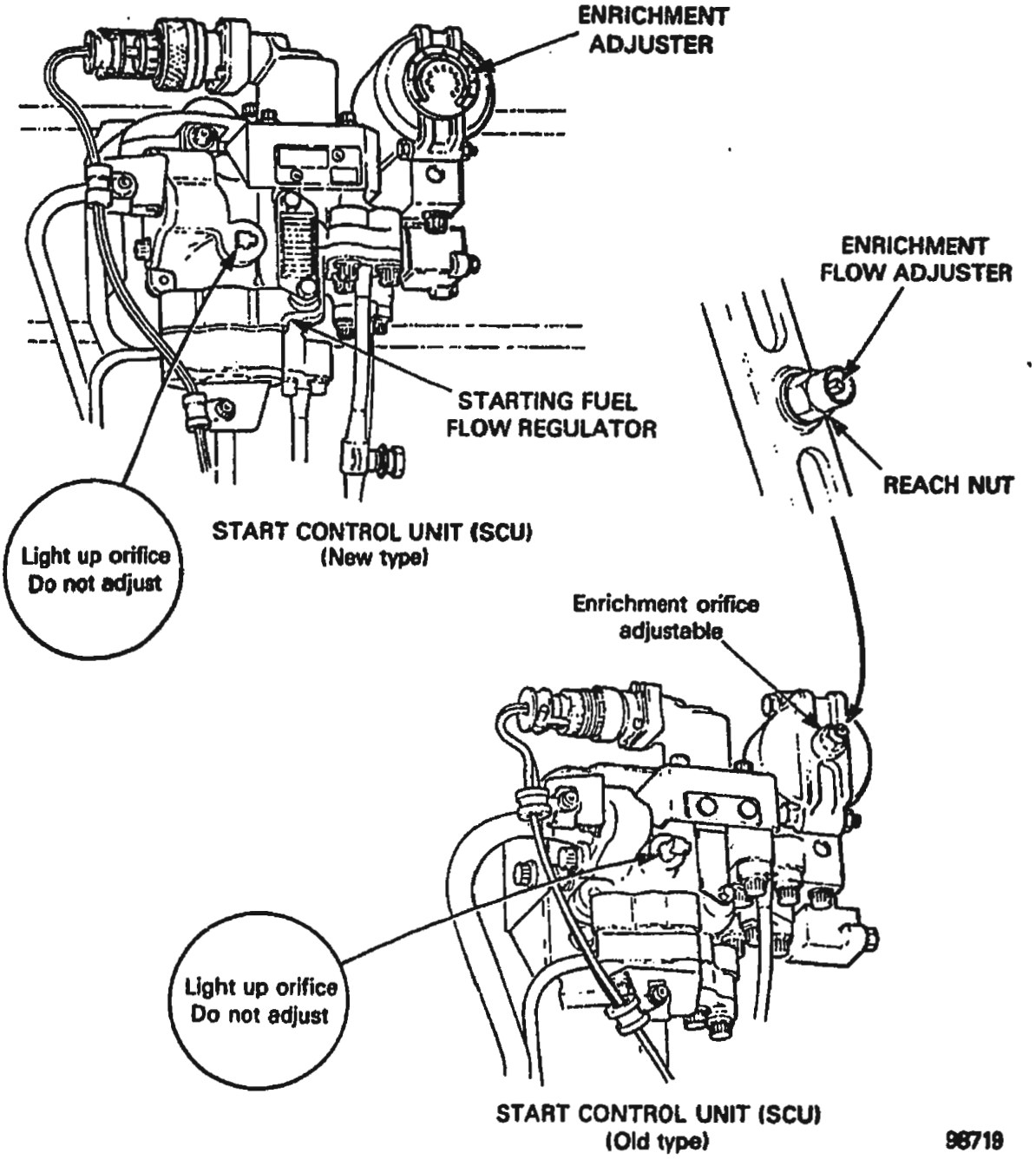
S.B.71-4176 - General Service harness modified to suit Fuel Flow Regulator Calibration V.
Lucas S.B.SCU 101-73-17 (RR.S.B.73-3967) - Single Handed Enrichment Flow Adjuster (Mod.CP.5173)

CR A. Start Control Unit (SCU) Adjustment

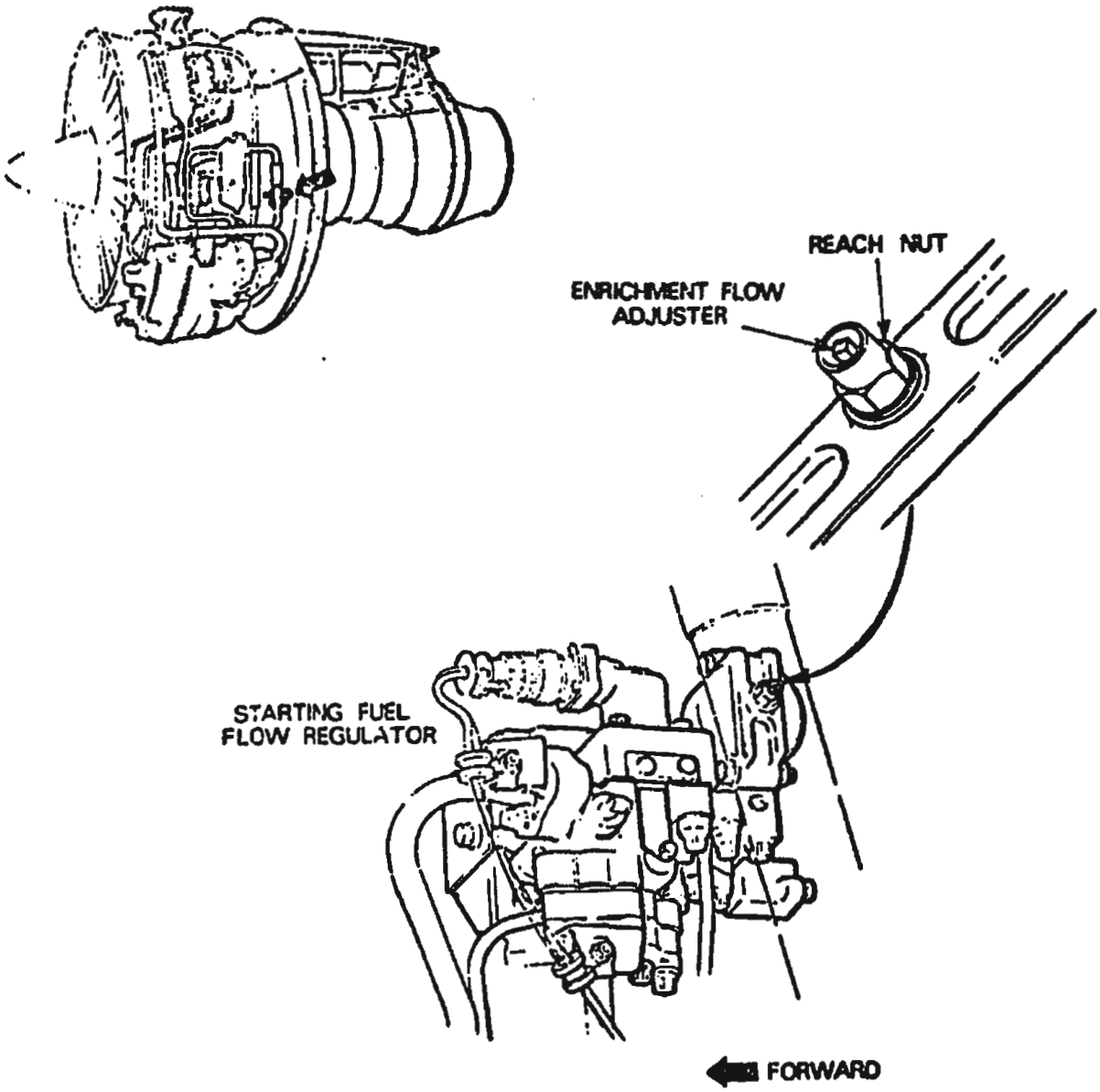
CR (1) Start control units are being returned to overhaul with the light up orifice adjustment altered. As the Maintenance Manual indicates, this is shop set and potted over with RTV and not to be adjusted in the field. Any adjustment can result in engine overtemp during starting. Removal of the RTV or field adjustment requires the SCU be removed and sent to overhaul for recalibration.

CR (2) Illustrations of the SCU adjustments are shown in Figure 203. As indicated, there sre two type SCUs - both interchangeable. The older type has an enrichment flow adjustment secured by a reach nut (jam nut). The nominal setting is flush. To lean out fuel, turn clockwise in 1/4 turn adjustments (for hot starts). To richen fuel, adjust counter clockwise in 1/4 turn increments. Removal of the cannon plug completely deactivates the SCU function, making the unit as lean as possible.

CR (3) The new type SCU enrichment adjustment is a vernier type with numbered adjustments. The Number 3 is nominal. Movement to the right leans out the fuel and to the left richens it. Again, removal of the cannon plug deactivates the unit. For this reason, any time the cannon plug is removed for starting, it must be reinstalled for dispatch.

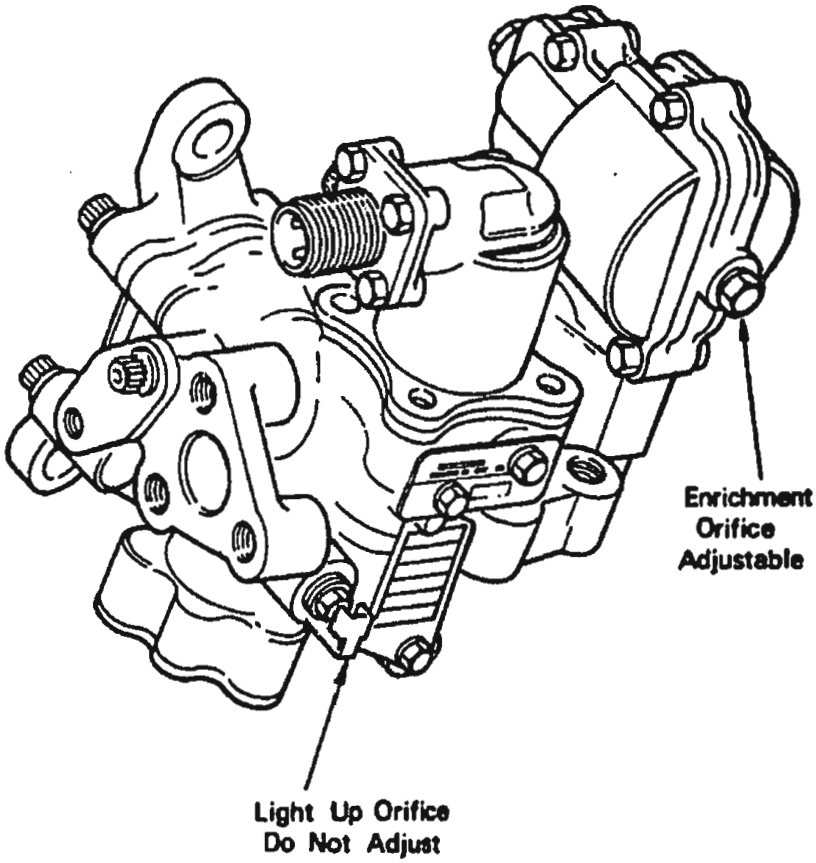


CR Start control unit (SCU)
CR Fig.203



Starting fuel flow regulator enrichment fuel flow adjuster
Fig.203A

NOTE: Only the enrichment orifice may be adjusted in the field. Adjustment of the light up orifice introduces an error in fuel flow calibration that affects the entire range of the fuel flow regulator.



C Start fuel flow regulator
C or Start Control Unit (SCU)
C Figure 203B

CR (4) CAUTION: DO NOT TAMPER WITH THE LIGHT UP ORIFICE
CR ADJUSTMENT IN THE FIELD
CR The light up orifice adjustment is the same on both
CR units. This is a guarded cover and potted.

B. Adjust Starting Fuel Flow Regulator Enrichment Flow -
C RB211-22B engines featuring Lucas S.C.U.101 Mark 3 and 7 or 11 not incorporating Lucas S.B.SCU101-73-17

(1) Equipment required:

UT.343 Adjusting tool

(2) Open left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL (Ref. 71-12-01) and 433DL (Ref. 71-12-05) for engine No.2.

(3) Increase enrichment fuel flow:

NOTE: The enrichment flow adjuster setting must be checked with the reach nut tightened.

CR (a) Refer to fig.203A, check enrichment adjuster is in nominally correct position, flush with end of reach nut.

(c) CAUTION: 1. IF AFTER ADJUSTMENT COMPRESSOR STALLS OR HOT STARTS OCCUR TURN ADJUSTER CLOCKWISE AND RESET NEARER TO THE NOMINAL (FLUSH) POSITION.

2. IF AFTER ADJUSTMENT, ENGINE ACCELERATION TO GROUND IDLE CONTINUES TO BE SLOW NO FURTHER ADJUSTMENT MUST BE MADE. CONTINUE WITH TROUBLE SHOOTING.

Slacken reach nut and using tool UT343, screw adjuster anti-clockwise up to a maximum of three
C quarters of a turn above flush then tighten reach
C nut. Adjustments should be made in quarter turn
C increments.

(4) Decrease enrichment fuel flow

NOTE: The enrichment flow adjuster setting must be checked with the reach nut tightened.

CR (a) Refer to fig.203A, slacken reach nut and using tool UT343, screw adjuster clockwise until end of adjuster is flush with end of reach nut then tighten reach nut.

(b) If adjuster is already flush with end of reach nut or if further decrease of fuel flow is required, proceed as detailed in operation (c).

(c) CAUTION: 1. ADJUSTMENT IN EXCESS OF 1/3 OF A TURN UNDER FLUSH CAN RESULT IN DAMAGE TO THE UNIT.

2. IF AFTER ADJUSTMENT SLOW ACCELERATION DURING ENGINE STARTING IS EXPERIENCED OR ENGINE CONTINUES TO HOT START, RESET ADJUSTER TO FLUSH POSITION AND CONTINUE WITH TROUBLE SHOOTING.

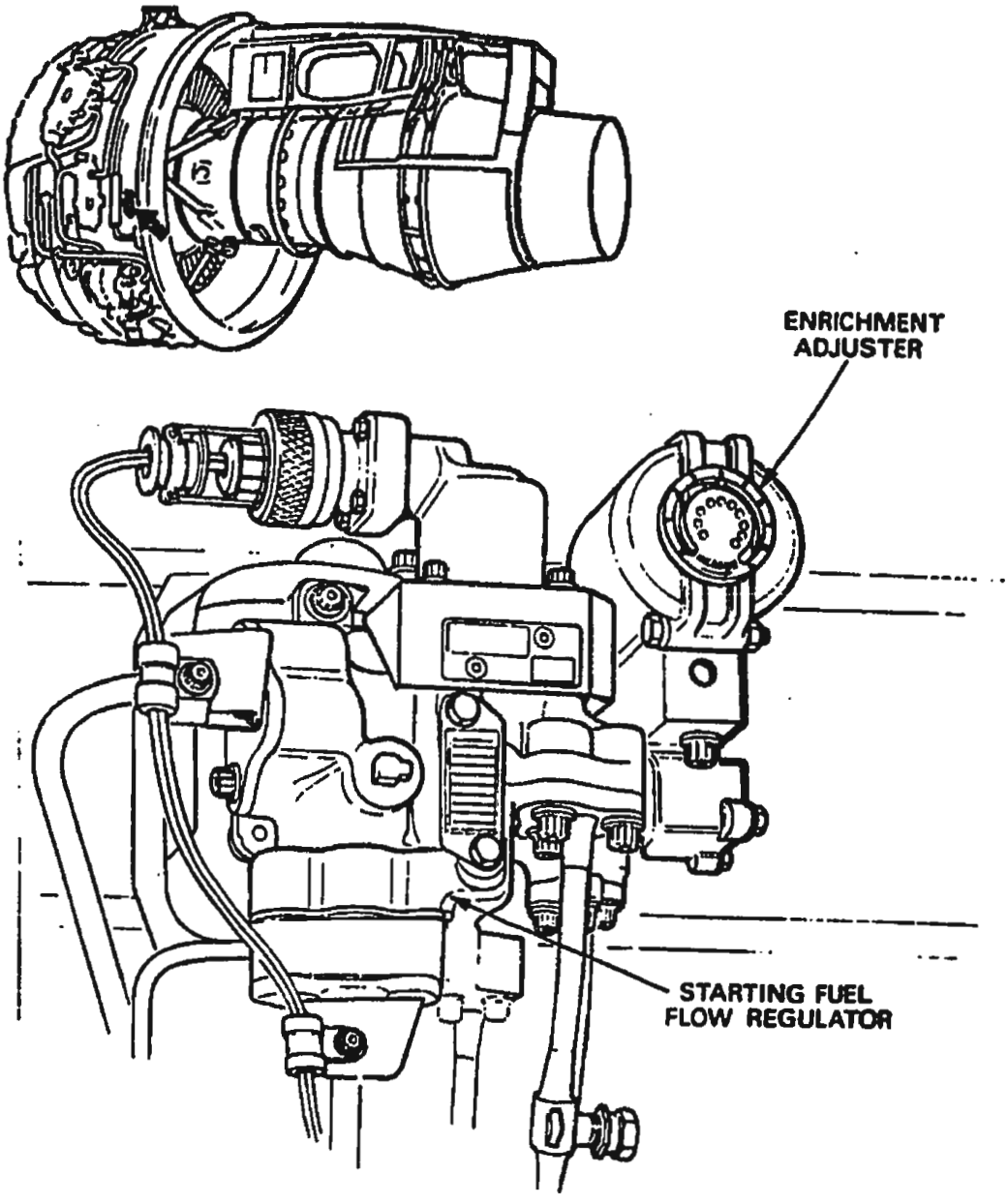
C Slacken reach nut and using tool UT343 screw
C adjuster up to a maximum of three quarters of a
C turn clockwise on a Mark 3 (TWA 29218) or half a
C turn on a Mark 7 (TWA 29222), then tighten reach
C nut. Adjustments should be made in quarter turn
C increments. This underflush setting is only permissible if a satisfactory Ground Idle/Flight Idle Test is then accomplished. (Ref. 71-00-00,
C Adjustment/Test - Test No.2).

B. Adjust Starting Fuel Flow Regulator Enrichment Flow - Engines incorporating Lucas S.B.SCU101-73-17.

NOTE: The enrichment adjuster is nominally set at position 3.

(1) Open left-hand hinged cowl 413A or 423A for engines No.1 and 3 (Ref.71-11-00.) or 433AL for engine No.2 (Ref.71-12-01).

(2) Increase fuel flow



Starting fuel flow regulator enrichment flow adjustment
(Lucas S.B.SCU101-73-17)
Fig.204

(a) CAUTION: 1. IF AFTER ADJUSTMENT THE COMPRESSOR STALLS OR HOT STARTS OCCUR, ROTATE ADJUSTER CLOCKWISE TOWARDS NOMINAL SETTING

2. IF AFTER ADJUSTMENT, ENGINE ACCELERATION TO GROUND IDLE IS STILL SLOW CONTINUE WITH TROUBLE SHOOTING

Refer to Fig.204, rotate adjuster anti-clockwise.

(3) Decrease fuel flow

(a) CAUTION: IF AFTER ADJUSTMENT ACCELERATION DURING STARTING IS SLOW, ROTATE ADJUSTER ANTI-CLOCKWISE TO NOMINAL SETTING AND CONTINUE WITH TROUBLE SHOOTING.

Refer to fig.204, rotate adjuster clockwise. If it is necessary to use position 2 or 1, a Ground Idle/Flight Idle Test must be accomplished (Ref. 71-00-00, Adjustment/Test - No.3).

(4) Close left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref.71-11-00) or 433L for engine No.2 (Ref.71-12-01).

C. Operationally Test Enrichment Solenoid - Engines not incorporating S.B.71-4176

(1) Open relevant circuit breakers to isolate electrical supply to engine ignition systems.

(2) Energize ground services system (Ref. 24-41-00).

(3) Open left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00, Servicing) or 433AL for engine No.2 (Ref. 71-12-01, Servicing).

(4) Select FUEL AND IGNITION switch, zone 210, to ON position and aurally check for enrichment solenoid operation. Select FUEL AND IGNITION switch OFF.

(5) Close left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL (Ref. 71-12-01) for engine No.2.

(6) De-energize ground services system (Ref. 24-41-00).

(7) Close circuit breakers opened in operation (1).

D. Operationally Test Enrichment Solenoid - Engine incorporating S.B.71-4176

(1) Open relevant circuit breakers to isolate electrical supply to engine ignition systems.

(2) Energize ground service system (Ref. 24-41-00).

(3) Open left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00, Servicing or 433AL for engine No.2 (Ref. 71-12-01, Servicing).

(4) Press ground start switch light and aurally check for enrichment solenoid operation.

(5) Press ground start release switch.

(6) Close left-hand hinged cowl 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL for engine No.2 (Ref. 71-12-01).

(7) De-energize ground service system (Ref. 24-41-00).

(8) Close circuit breakers opened in operation (1).

R # FUEL SYSTEM AIR TUBES - REMOVAL/INSTALLATION

R 1. ## Centrisep Air Cleaner - Removal/Installation

R A. Referenced Procedures:

R 70-51-00 Torque Tightening Techniques
R 71-11-00 Cowling, engines No.1 and No.3 - Servicing
R 71-12-01 L.H. and R.H. lower hinged cowl - Servicing

R B. Illustrated Parts Catalogue References:

R The I.P.C. sections where parts disturbed during the
R following operations can be located are as follows:

R 71-50-01 Electrical Harness - Light Duty
R 73-21-04 Fuel System Air Tubes

R C. Remove Centrisep Air Cleaner.

R (1) Open L.H. hinged cowl (ref 71-11-00) 413 or 423 for
R engine No.1 or No.3, or hinged cowl (ref 71-12-01)
R 433 for engine No.2.

R (2) Ref fig.401 Disconnect connector (1).

R (3) Remove bolts and nuts (2) leaving bracket (3)
R attached to harness, then remove Centrisep (4).
R Loosen adaptor bolts to facilitate removal if necessary.

R (4) Fit blanks to all exposed opertures and connectors.

R D. Install Centrisep Air Cleaner.

R (1) Materials required:

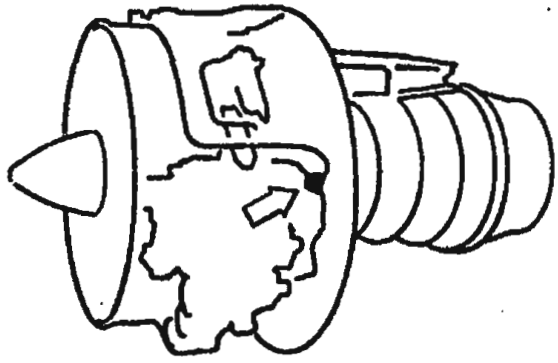
		British Spec./Ref.	American Spec./Ref.	OMat Item No.
R	Lockwire	DTD189A 22S.W.G.	21A.W.G.	238

R (2) Remove all blanks from apertures and connectors.

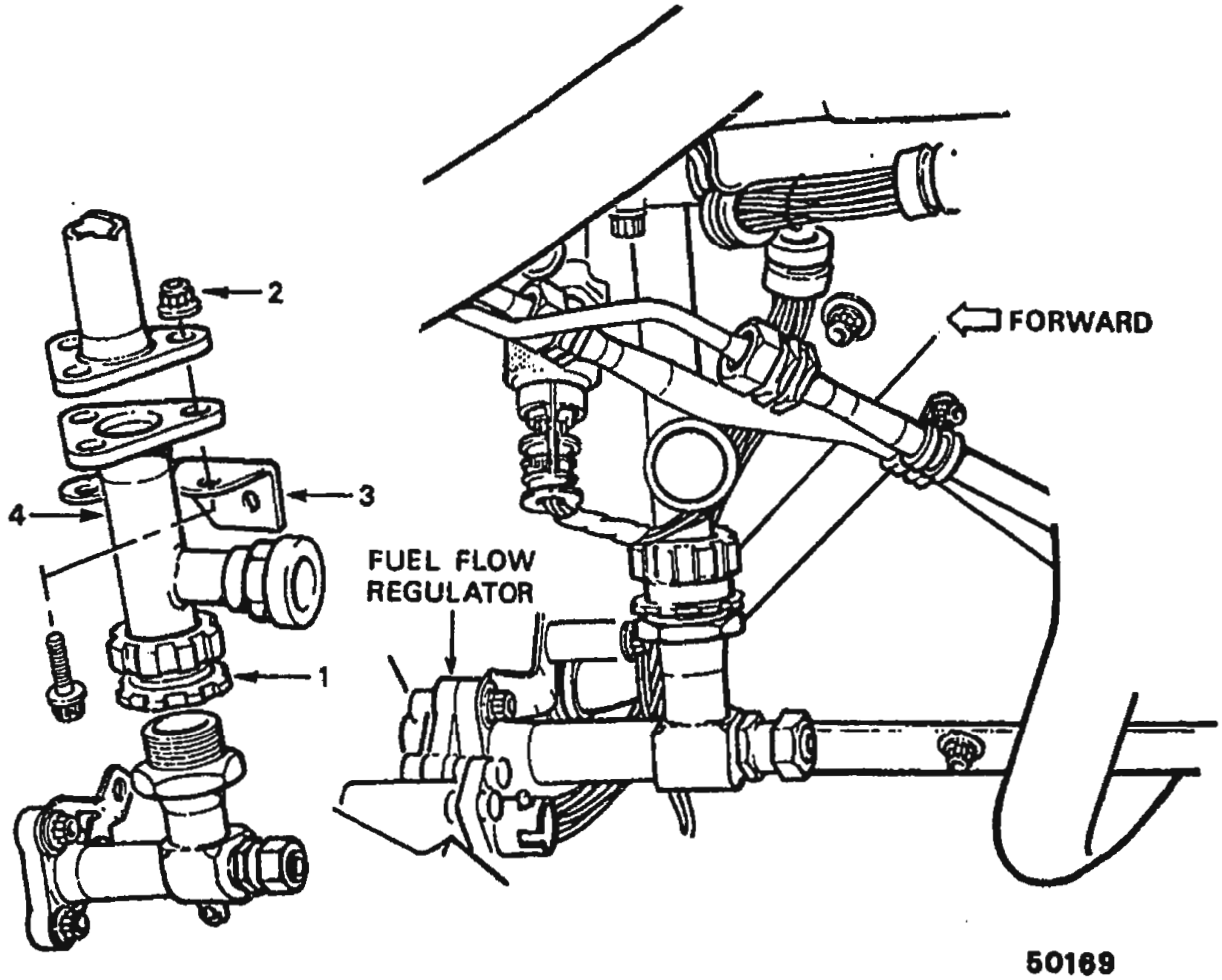
R (3) Position centrisep (4) and secure with nuts and bolts
R (2) and bracket (3).

R (4) Secure (ref 70-51-00) connector (1) and wirelock,
R then tighten adaptor bolts if loosened at 1C (3).

R (5) Close hinged cowl (ref 71-11-00) 413 or 423 for
R engine No.1 or No.3 and (ref 71-12-01) 433 for
R engine No.2.



1. CONNECTOR
2. NUTS AND BOLTS
3. BRACKET
4. CENTRICEP



R Centrisep Air Cleaner - Removal/Installation
R Fig.401

R EFFECTIVITY: ALL

FUEL SYSTEM AIR TUBES - INSPECTION/CHECK

R 1. Air Tubes - Inspection/Check

R A. Inspect Air Tubes

(1) Inspect air tubes for cracks, dents, nicks, fretting and scoring.

B. Acceptance Standards

(1) Cracks - No cracks acceptable

(2) Dents - Smooth dents of large area relative to depth, which do not reduce the diameter of the tube by more than 10 per cent at any one point, providing they are not within one diameter or 0.500in. (12,7 mm.), whichever is the greater, of the tube end fitting, or on the outside surface of a bend

Smooth dents of small area up to 0.125sq.in. (3,17 sq.mm.) providing they are round bottomed and their depth does not exceed 0.015in. (0,381 mm.) on outside surface of a bend; 0.025in. (0,635 mm.) on remaining section of tube, and also providing that they are not within one diameter or 0.500in. (12,7 mm.), whichever is the greater, of the tube end fitting.

(3) Nicks - Nicks that are round bottomed providing they do not exceed 0.004in. (0,101 mm.) in depth and all burrs are removed.

(4) Fretting - Fretting up to a maximum depth of 0.007in. (0,177 mm.) on outside surface of a bend; 0.010in. (0,254 mm.) on remaining sections of tube.

(5) Scoring - Light scoring can be blended out providing not more than 0.005in. (0,127 mm.) of metal in depth is removed from tube wall.

R 2. Centrisep Air Cleaner - Inspection/Check

R A. Referenced Procedures:

R 73-21-04 Fuel System Air Tubes - Removal/Installation

R B. Centrisep Filter Inspection

R (1) Remove centrisep air cleaner (Ref.73-21-04).

R (2) Visually inspect inlet filter for signs of damage
R or blockage due to contamination.

R (3) Clean by reverse flowing clean dry air through
R the unit (Max. perssure 100 p.s.i.).

R (4) If cleaning fails to remove the contamination or
R filter is found damaged reject unit for repair.

R (5) Install centrisep air cleaner (Ref. 73-21-04).

P1 PROBE AND TUBES, ENGINES NO.1 AND 3 - MAINTENANCE PRACTICES

R Referenced Procedures:

R 6-40-00 Exterior Access Doors and Panels Description/Operation
R 70-51-00 Torque Tightening Techniques
R 73-11-09 Fuel Tubes Inspection/Check

1. Removal/Installation P1 Probe

A. Remove P1 Probe

(1) Equipment required:

289200 Protective work mats
R UXT40959 Working platform (nose cowl)

(2) Remove fairing 451AT or 461AT for engines No.1 and 3 (Ref. 6-40-00).

(3) Refer to fig.201, remove bolts and washers (1) then remove panel (2).

(4) Disconnect connectors (3) and (4).

(5) Position protective work mats in nose cowl air intake.

(6) CAUTION: BEFORE REMOVING NUTS AND WASHERS (5) THE P1 PROBE MUST BE SUPPORTED FROM INSIDE THE AIR INTAKE.
Remove nuts and washers (5) then withdraw P1 probe.

(7) Fit approved blanks to all exposed apertures and connectors.

R B. Inspect P1 Probe

R (1) Refer to fig.202, inspect P1 probe visible welds for
R cracking. If cracked, reject P1 probe.

R (2) Inspect tubes and connectors as detailed in (73-11-09)
R Inspection/Check.

R C. Install P1 Probe

(1) Equipment required:

289200 Protective work mats

(2) Material required:

	British Spec./Ref.	American Spec./Ref.	OMat Item No.
Lockwire	189A 22 S.W.G.	- 21 A.W.G.	238

(3) Ensure protective work mats are positioned in air intake.

(4) Remove blanks, if fitted, from all apertures and connectors.

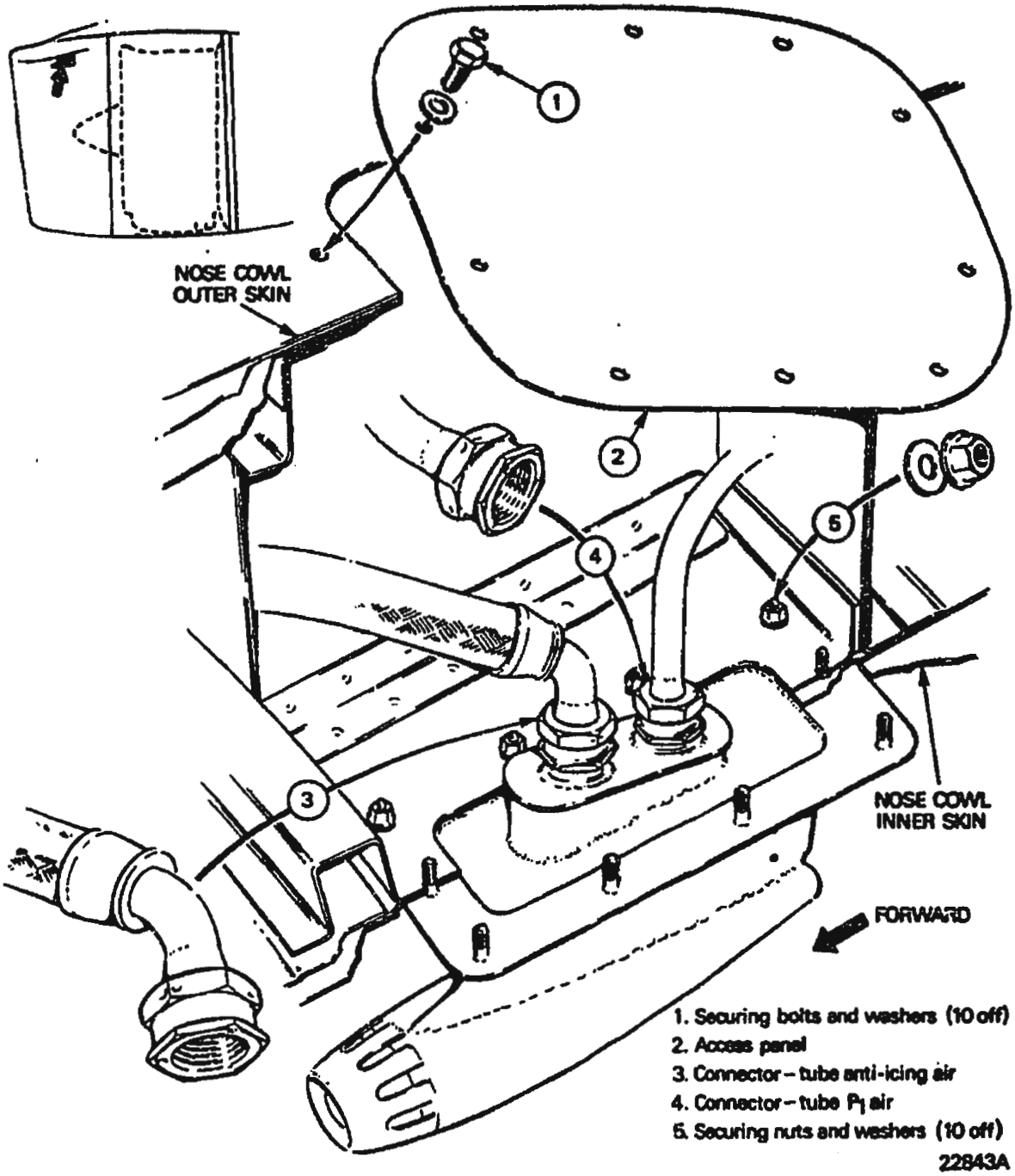
(5) Refer to fig.201, locate P1 probe on inside of air intake then fit and secure washers and nuts (5).

(6) CAUTION: CORRECT TUBE ALIGNMENT IS ESSENTIAL AND TORQUE VALUES (REF. 70-51-00, PARA.10) MUST NOT BE EXCEEDED.
Connect and tighten (Ref. 70-51-00) connectors (4) and and (3) then wirelock.

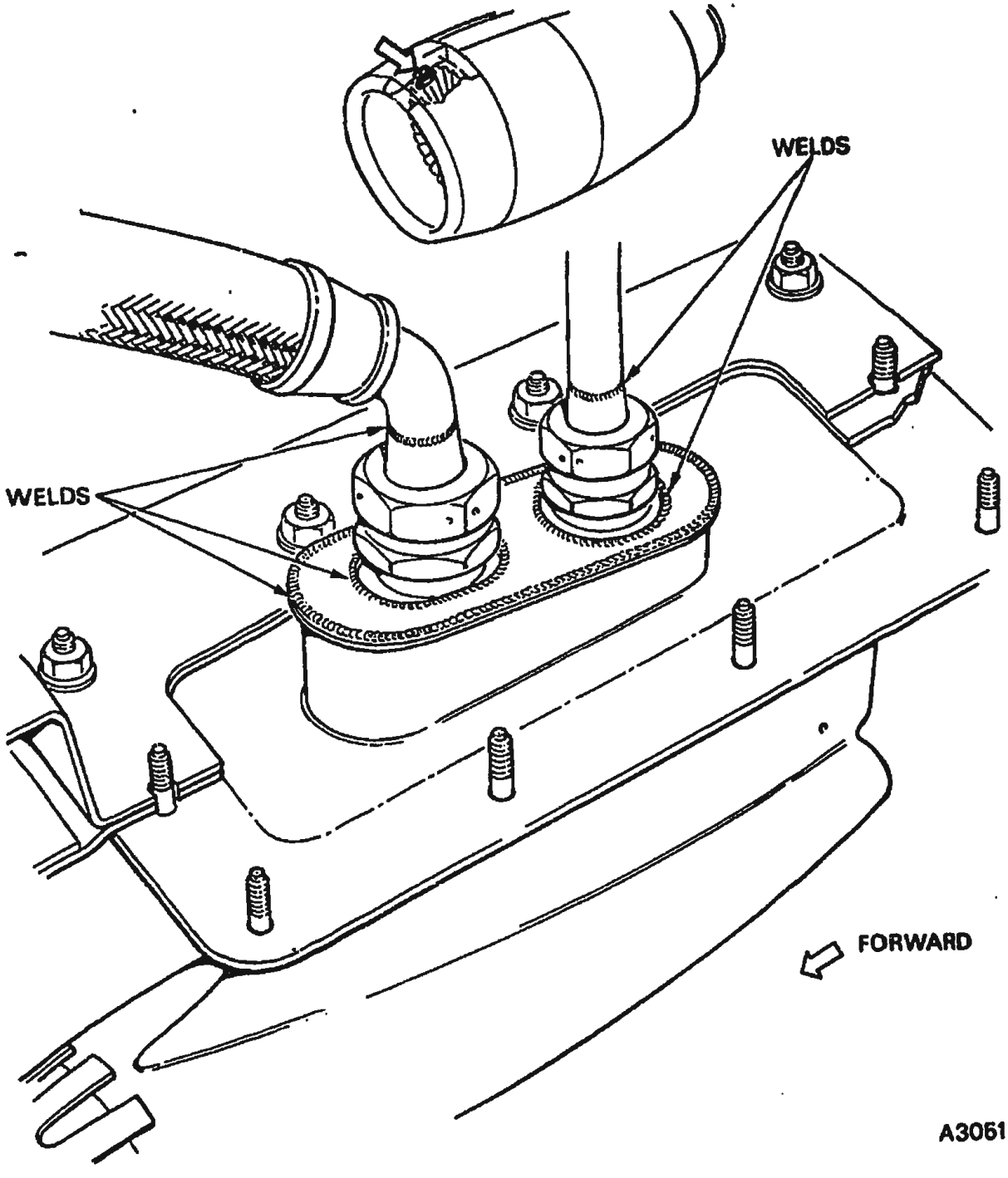
(7) Fit panel (2) and secure with washers and bolts (1).

(8) Remove protective mats from air intake.

(9) Fit and secure fairing 451AT or 461AT for engines No.1 and 3 (Ref. 6-40-00).


NOSE COWL OUTER SKIN
NOSE COWL INNER SKIN
FORWARD
1. Securing bolts and washers (10 off)
2. Access panel
3. Connector – tube anti-icing air
4. Connector – tube P_1 air
5. Securing nuts and washers (10 off)
22843A

P1 probe disconnect points
Fig.201



R
R

P1 probe Inspection Areas
Fig.202

COLD DAY ENRICHMENT SOLENOID - MAINTENANCE PRACTICES

1. Adjustment/Test Cold Day Enrichment Solenoid

   A. Operational Test

      (1) Open relevant circuit breakers to isolate electrical supply to engine ignition systems.

      (2) Energize ground services system (Ref. 24-41-00).

      (3) Open left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL for engine No.2 (Ref. 71-12-00).

      (4) Select and hold relevant FUEL AND IGNITION switch, zone 210, to ENRICHMENT position and aurally check for cold day enrichment solenoid operation. Release switch and select OFF.

      (5) Close left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433AL for engine No.2 (Ref. 71-12-00).

      (6) De-energize ground services system (Ref. 24-41-00).

      (7) Close circuit breakers opened in operation (1).

FUEL ENRICHMENT SOLENOID - ADJUSTMENT/TEST

1. Test Fuel Enrichment Solenoid

R CAUTION: ON PILOTS OVERHEAD CIRCUIT BREAKER PANEL CB1 ZONE 210,
R OPEN AND TAG ENGINE CIRCUIT BREAKER FUEL SHUT OFF
R VALVES -TANK - ENGINE (D10, D11 or D12) AND FUEL SHUT
R OFF (F16, F17 OR F18).

A. Operational Test

(1) On Pilots overhead circuit breaker panel CB1 zone 210, open and tag appropriate B START IGN circuit breaker (F13, F14 or F15).

(2) On Pilots overhead circuit breaker panel CB1 zone 210, ensure appropriate ENGINE START CONT circuit breaker (E13, E14 or E15) is closed.

(3) On Flight Engineers/Second Officers circuit breaker panel CB3, zone 215, open and tag appropriate START IGN SYS A circuit breaker (N6, N12, or N18), open and tag CONT IGN SYS A circuit breaker (R8), CONT IGN SYS B circuit breaker (R9) and ALL ENG CONT IGN SEL circuit breaker (L18).

(4) Energize ground services system (Ref. 24-41-00).

(5) Open left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433DL for engine No.2 (Ref. 71-12-05).

(6) Select and hold relevant FUEL AND IGNITION switch, zone 210, to ENRICHMENT position and aurally check for fuel enrichment solenoid operation. Release switch and select OFF.

(7) Close left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or 433DL for engine No.2 (Ref. 71-12-05).

(8) De-energize ground services system (Ref. 24-41-00).

(9) Reactivate systems deactivated in operations (1) to (3).

P4/PF SWITCH - MAINTENANCE PRACTICES

1. Removal/Installation P4/PF Switch

A. Remove P4/PF Switch

(1) Tag throttle levers and thrust reverser levers. Tag APU/GRD AIR TO REVERSERS switches.

(2) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag appropriate START AIR VALVE circuit breaker.

(3) Tag appropriate ENGINE START panel switchlights.

(4) Open left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00, Servicing) or 433AL for engine No.2 (Ref. 71-12-01, Servicing).

(5) Refer to fig.201, disconnect electrical connector (1).

(6) Disconnect connectors (2) and (3).

(7) Support switch, remove bolts and washers (4) then lift switch from bracket.

(8) Fit approved blanks to all exposed apertures and connectors.

B. Install P4/PF Switch

(1) Material required:

Stainless steel locking wire: British gauge 21 S.W.G.
American gauge 22 A.W.G.

(2) Ensure appropriate systems are tagged as detailed in operations A (1) through (3).

(3) Remove blanks, if fitted, from all exposed apertures and connectors.

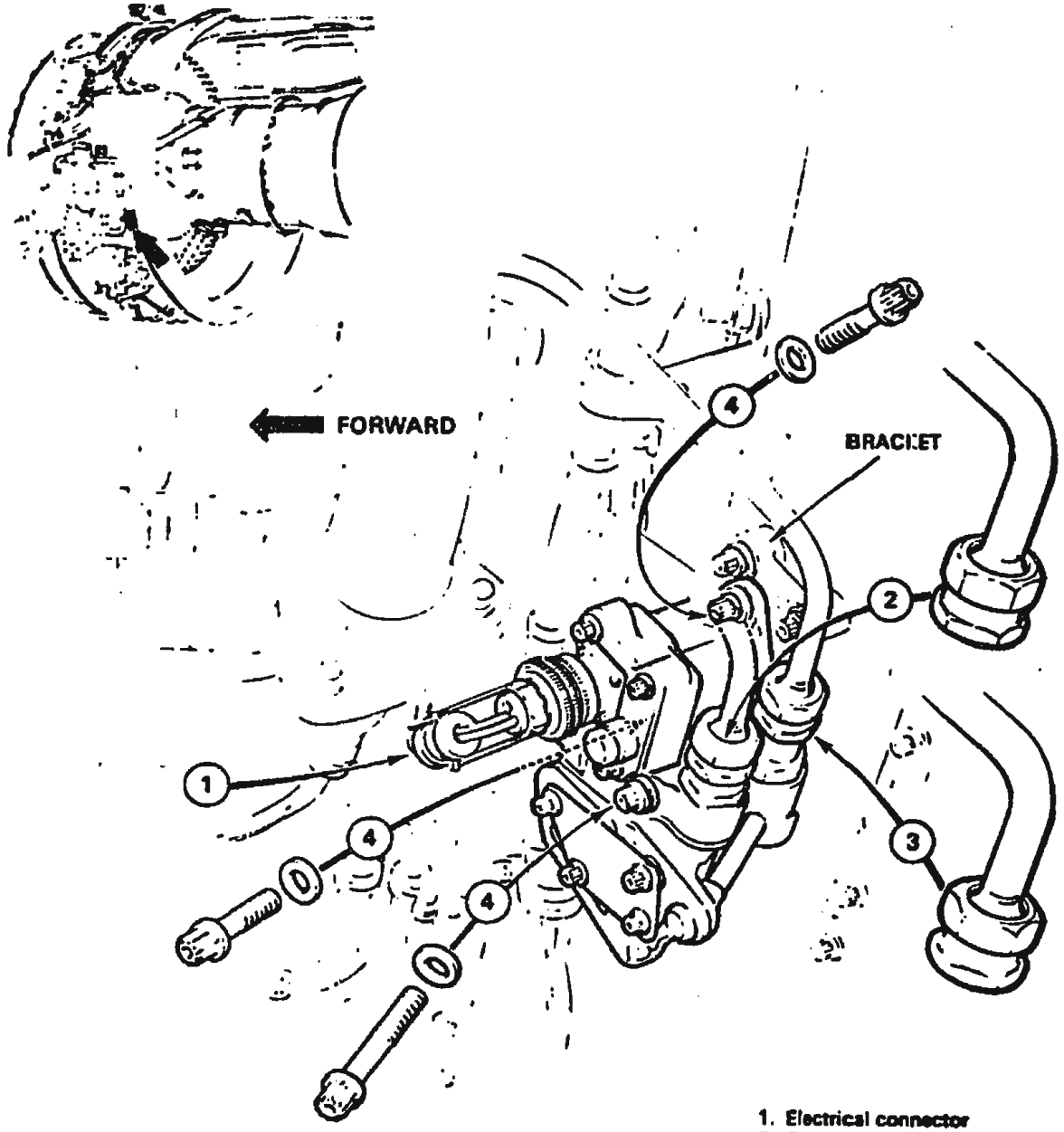
(4) Refer to fig.201, position switch on bracket and secure with bolts and washers (4).

(5) Fit and secure (Ref. 70-51-00) connectors (3) and (2) and wirelock.

(6) Connect and secure electrical connector (1).

(7) Remove tags and close circuit breakers opened in operations A (1) through (3).

(8) Close left-hand hinged cowl, 413A or 423A for engines No.1 and 3 (Ref. 71-11-00, Servicing) or 433AL for engine No.2 (Ref. 71-12-01, Servicing).



1. Electrical connector
2. Connector–P_4 air
3. Connector–P_F air
4. Securing bolt and washer (3 off)

26101

P4/PF Switch Disconnect Points
Fig.201

N2 SPEED SWITCH - REMOVAL/INSTALLATION

1. Removal/Installation N2 Speed Switch (S8E10/4 or S8E10/5)

Service Bulletins referred to:

S.B.73-2575 - Introduction of I.P. Compressor Speed Governor Unit
S.B.71-3351 - Harness to Suit Modified Amplifier and Speed Switch
Ultra S.B.73-21-03 (Mod. RD201) - Conversion of N1 Channel Control (S8E10/4) to N2 Channel Control and Introduction of External Re-datum Test Facility (S8E10/5).

Referenced Procedures:

71-11-00 Cowling, Engines No.1 and 3 - Servicing
71-12-05 L.H. and R.H. Upper Hinged Cowls - Servicing
73-21-00 Engine Fuel Control System - Adjustment/Test

Illustrated Parts Catalogue References:

The I.P.C. sections where parts disturbed during the following operations can be located are as follows:

73-21-16 N2 Speed Switch

A. Remove N2 Speed Switch

(1) Open L.H. hinged cowl 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or L.H. upper hinged cowl 433DL for engine No.2 (Ref. 71-12-05).

(2) CAUTION: ENSURE ELECTRICAL CONNECTOR IS FREE FROM LIQUID AND/OR SOLID CONTAMINATION BEFORE DISCONNECTING. FAILURE TO DO SO COULD RESULT IN A FIRE.
Refer to fig.401, disconnect electrical connector (1).

CR (3) WARNING: FAILURE TO REMOVE THE ELECTRICAL CONNECTION
CR OR TO PULL THE APPROPRIATE CIRCUIT BREAKER
CR WILL CAUSE AN ELECTRICAL SHOCK WHEN REMOVING
CR THE N2 SPEED SWITCH. THE SPEED SWITCH HAS
CR A 50 VOLT POTENTIAL BETWEEN THE ENGINE
CR MOUNTED BRACKET AND N2 SWITCH CASE.
Remove bolts and washers (2) then remove speed switch (3) from support bracket.

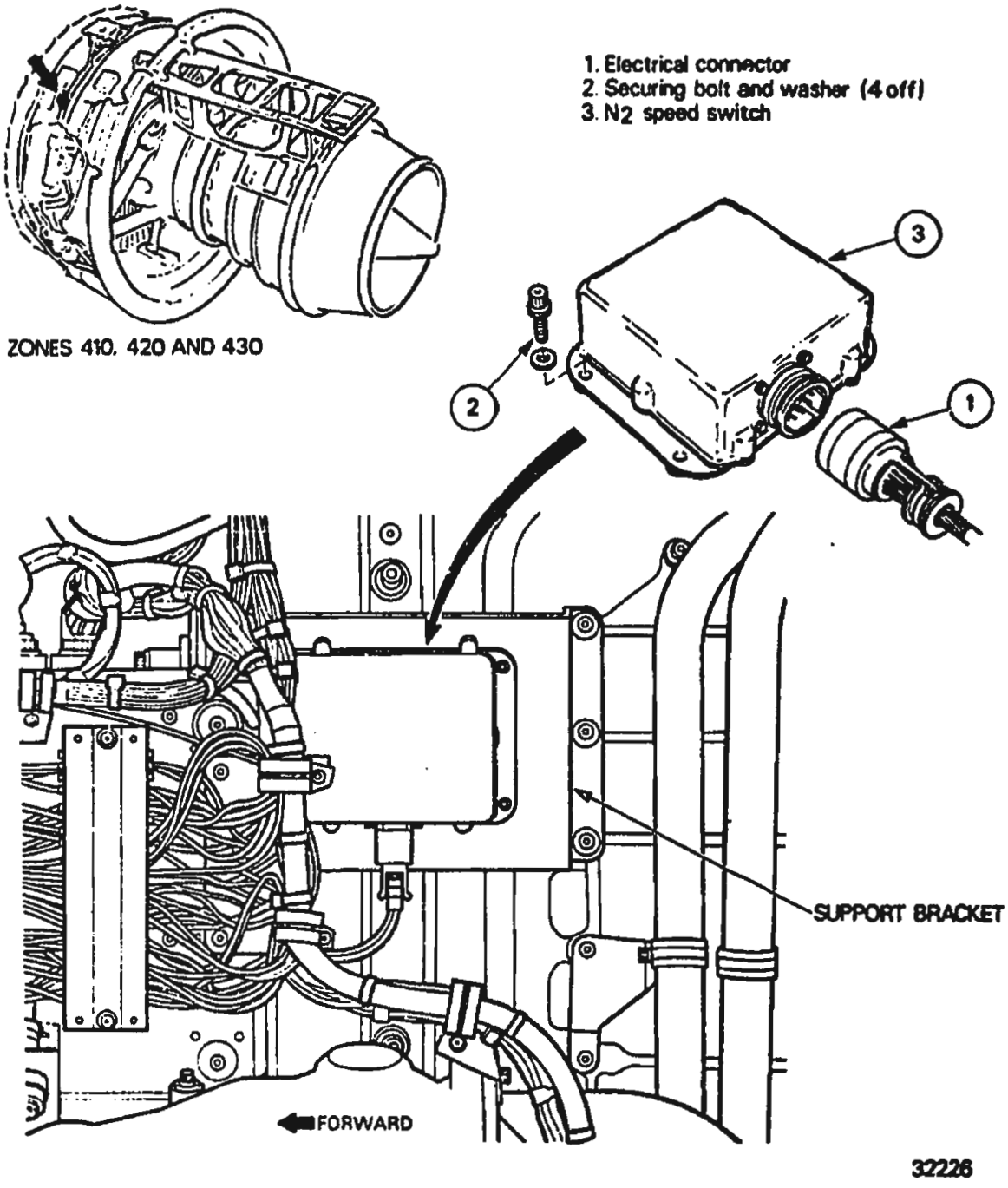
B. Install N2 Speed Switch

(1) Refer to fig.401, position speed switch (3) on support bracket and secure with bolts and washers (2).

(2) CAUTION: ENSURE ELECTRICAL CONNECTOR IS FREE FROM LIQUID AND/OR SOLID CONTAMINATION BEFORE CONNECTING. FAILURE TO DO SO COULD RESULT IN A FIRE.
Connect and secure electrical connector (1).

(3) Close L.H. hinged cowl 413A or 423A for engines No.1 and 3 (Ref. 71-11-00) or L.H. upper hinged cowl 433DL for engine No.2 (Ref. 71-12-05).

(4) Before next flight, functionally test speed switch datum settings (Ref. 73-21-00).



N2 speed switch removal/installation
Fig.401

HIGH FREQUENCY FILTER UNIT - MAINTENANCE PRACTICES

CR Engine No.2 with STA103 amplifier International Aircraft only.

1. Removal/Installation Filter Unit

Referenced Procedure:

71-12-05 L.H. Upper Hinged Cowl - Servicing

Illustrated Parts Catalogue Reference:

The I.P.C. section where the parts disturbed during the following operations can be located is as follows:

73-21-21 High Frequency Filter Unit Installation

Service Bulletin referred to:

S.B.72-3732 - Re-routing of the L.D. electrical harness down the A frame.

CR A. Remove Filter Unit (Engine No.2 only)

(1) On flight engineer's/second officer's aft circuit breaker panel CB3, zone 215, open and tag relevant FUEL CONT. AMP circuit breaker.

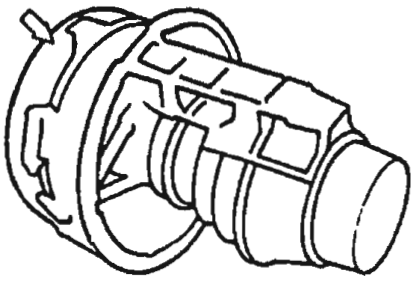
(2) On pilot's centre console, zone 210, switch relevant Fuel Control Amplifier test switch to OFF.

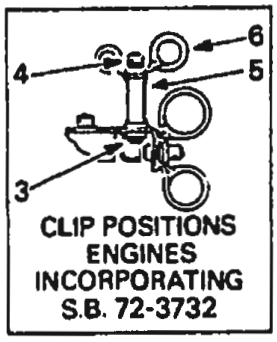
(3) On pilot's overhead control panel, zone 210, pull relevant Fire Emergency Shut-off Control.

(4) Open and secure L.H. upper hinged cowl 433DL (Ref. 71-12-05).

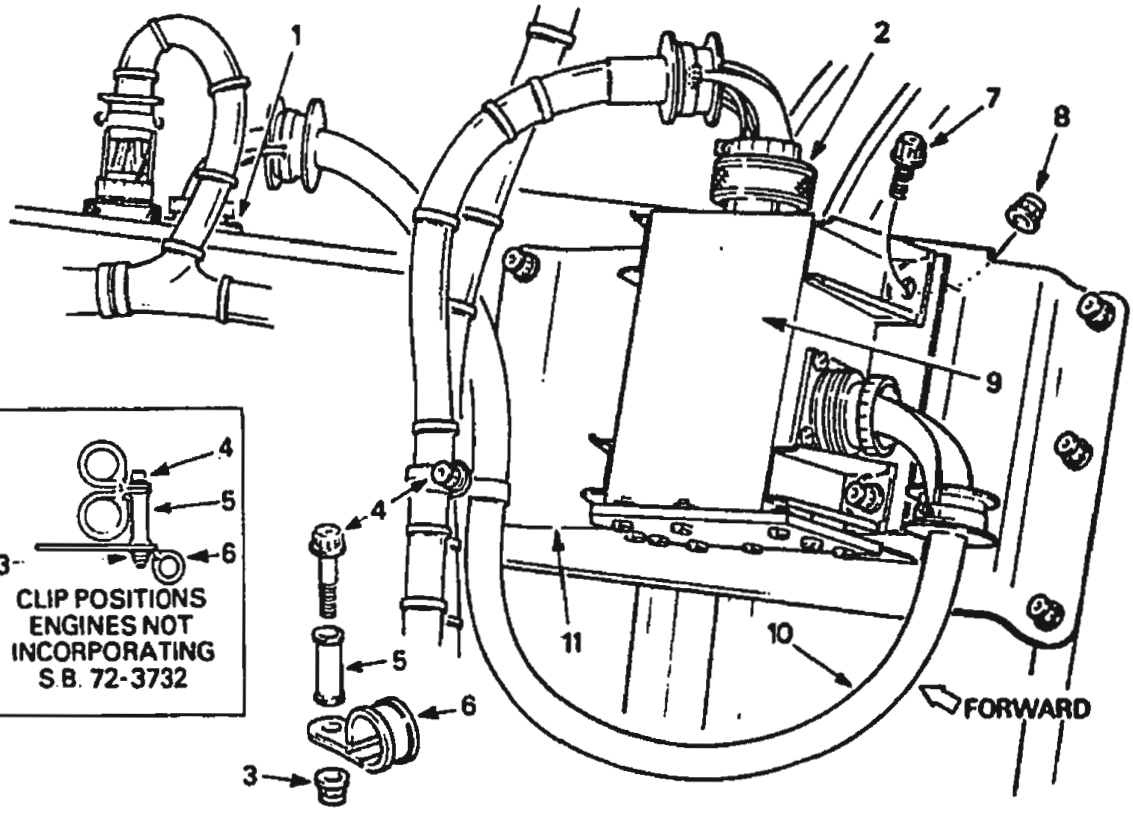
(5) CAUTION: ENSURE ELECTRICAL CONNECTORS ARE FREE FROM LIQUID AND/OR SOLID CONTAMINATION BEFORE DISCONNECTING.
Refer to fig.201, disconnect electrical connector (1) and (2).

(6) Remove nut (3) and withdraw bolt (4) and spacer (5).





1. CONNECTOR
2. CONNECTOR
3. NUT
4. BOLT
5. SPACER
6. CLIP
7. BOLT (4 OFF)
8. NUT (4 OFF)
9. FILTER UNIT
10. HARNESS ASSEMBLY
11. SUPPORT BRACKET

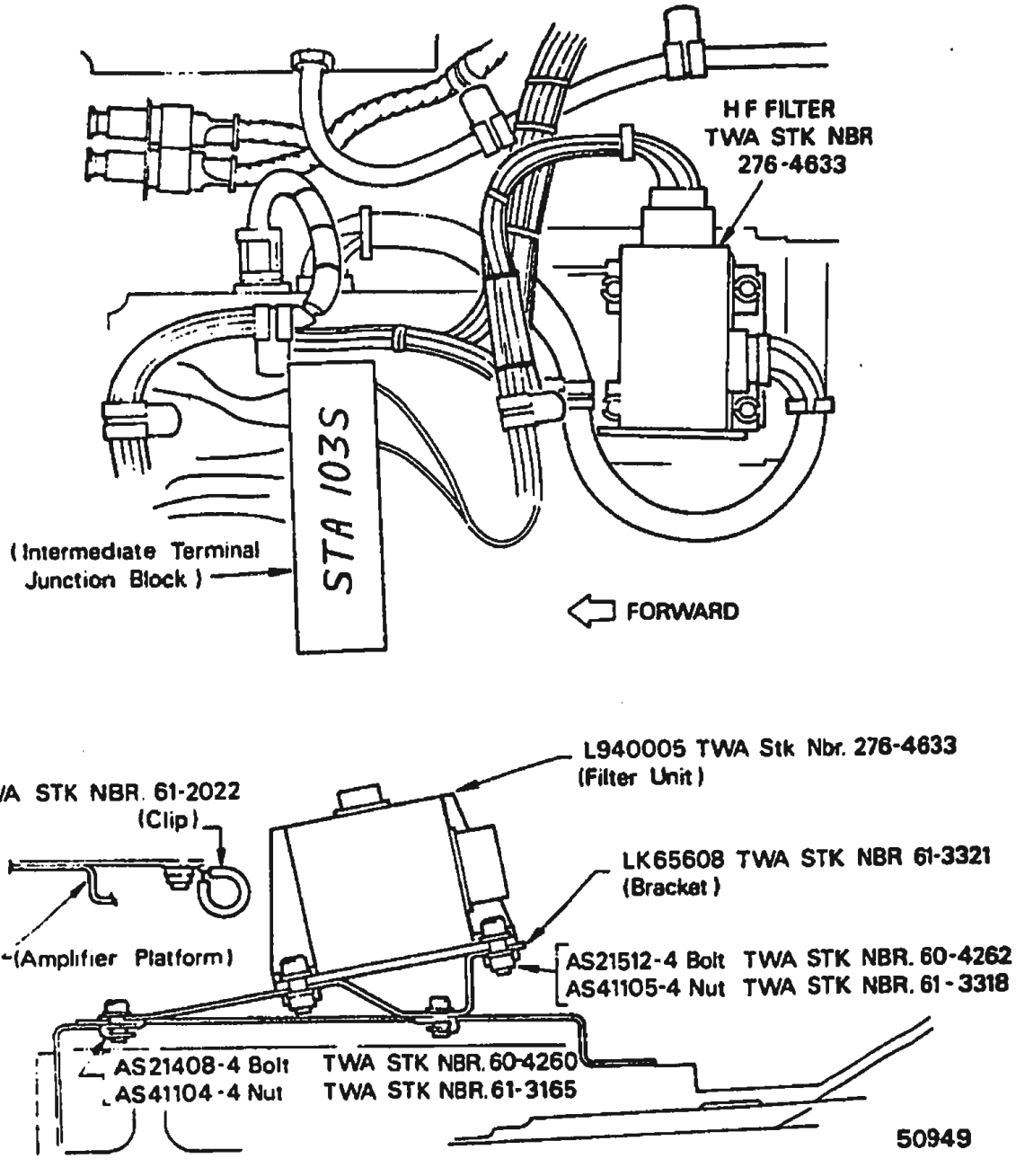


NOTE Refer to figure 201A for part numbers of filter and attaching hardware

50965

CR
CR

High frequency filter unit disconnect points
Fig.201



CR
CR

High frequency filter installation
Figure 201A

EFFECTIVITY: ALL: Engine No.2 with STA103 amplifier

(7) Remove clip (6) from harness assembly (10) then loosely re-fit spacer (5), bolt (4) and nut (3) to retain remaining clips in position.

(8) Remove bolts (7) and nuts (8) and remove filter unit (9) together with harness assembly (10) from support bracket (11).

(9) Fit approved blanks to all electrical connectors.

CR B. Install Filter Unit (Engine No.2 only)

(1) Ensure relevant systems are deactivated and tagged as detailed in operations A.(1) through (3).

(2) Remove blanks from all electrical connectors.

(3) Refer to fig.201, position filter unit (9) on support bracket (11), and secure with bolts (7) and nuts (8).

(4) CAUTION: ENSURE ELECTRICAL CONNECTORS ARE FREE FROM LIQUID AND/OR SOLID CONTAMINATION BEFORE CONNECTING.
Fit and secure electrical connector (1) to amplifier No.3 receptacle.

(5) Fit and secure electrical connector (2) to filter unit receptacle.

(6) Refer to fig.201 for correct position of the clip (6) on engines incorporating or not incorporating S.B.72-3732 then remove nut (3), bolt (4) and spacer (5) from clips, fit clip (6) to harness assembly (10) and secure clips with nut, bolt and spacer to amplifier mounting platform.

(7) Close L.H. upper hinged cowl 433DL (Ref. 71-12-05).

(8) Reactivate systems deactivated in operations A.(2) and (3), remove tag fitted in operation A.(1) and close the FUEL CONT. AMP. circuit breaker.

2. Filter Unit Adjustment/Test

A. Test Filter Unit

(1) Equipment required:

Ohmmeter or Wheatstone Bridge
R Insulation Test Meter (Megger) - 250V max. voltage

R (2) CAUTION: IT IS ESSENTIAL THAT THE FILTER UNIT IS
R DISCONNECTED FROM THE SPEED AND TEMPERATURE
R CONTROL AMPLIFIER BEFORE CARRYING OUT ANY
R OF THE FOLLOWING CHECKS.
Effect operations 1.A.(1) through (5).

(3) Connect ohmmeter or wheatstone bridge between corresponding harness connector socket and unit connector pin, excluding pins and sockets 2 and 3, and between unit connector pin 9 and unit case. Resistance at each reading should not be greater
R than 3 ohms.

(4) Connect ohmmeter or wheatstone bridge between sockets 2 and 3 of harness connector. Resistance should
R not be greater than 3 ohms. Remove test equipment.

R (5) Connect 250v meggar between each pin of unit connector and unit case, excluding pin 9. Resistance at each reading should be 20 megohms minimum. Remove test
R equipment.

R (6) Refer to fig.201, reconnect connectors (1) and (2).

R (7) Effect operations 1.B.(7) and (8).

INDICATING - DESCRIPTION AND OPERATION

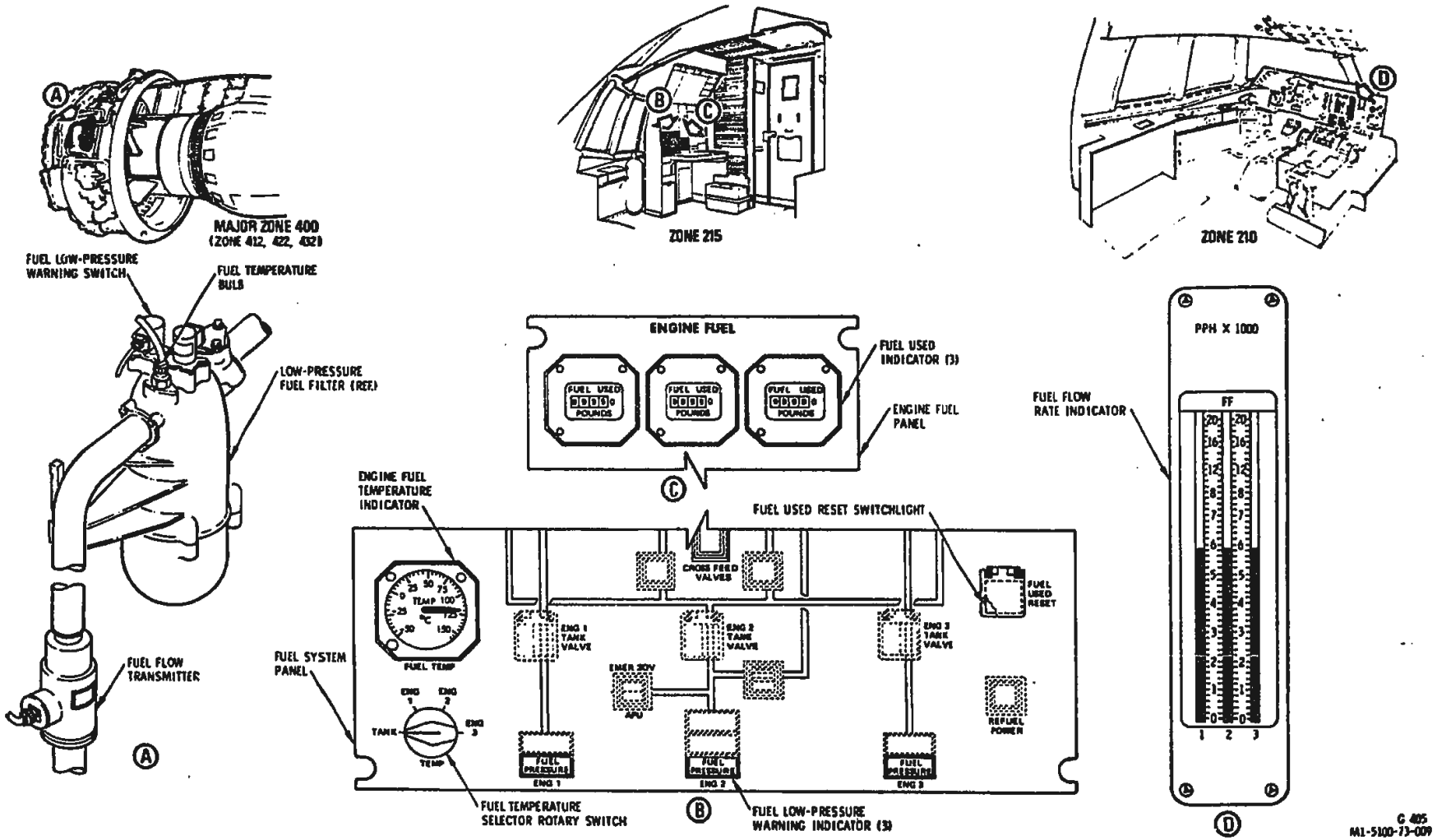
1. General

The status of engine fuel pressure, fuel consumed, and fuel temperature is provided to the Flight Engineer/Second Officer (Ref. Fig. 1). The pilots instrument panel fuel indication is limited to fuel flow rate.

The fuel pressure indicating system for each engine consists of a pressure-sensitive switch and an indicator light. The indicator lights are located on the Flight Engineer/Second Officer FUEL SYSTEM panel, zone 215.

A fuel flow transmitter at each engine provides electrical signals to the pilots fuel flow rate (FF) indicator and to the Flight Engineer/Second Officers FUEL USED indicator. The signals are conditioned in the indicators to provide the analog and digital displays.

Fuel temperature is sensed at each engine by a fuel temperature bulb and at fuel tank No. 2L by the wing tank fuel temperature sensor. A rotary switch permits selection of output signals from the applicable sensor for display on the FUEL TEMP indicator located on the Flight Engineer/Second Officers FUEL SYSTEM panel.



Engine Fuel and Control Indicating System Components
Figure 1

EFFECTIVITY: ALL

001B

FUEL PRESSURE SYSTEM - DESCRIPTION AND OPERATION

1. General

The engine fuel pressure indicating system provides a warning of low fuel pressure and of excessive pressure drop across the fuel filter. Each engine system consists of a normally closed pressure-sensitive switch, a fuel filter differential pressure switch, and an indicator light. The switches are mounted on the engine low-pressure (LP) fuel filter, zones 412, 422, and 432, in the LP side of the engine fuel system. The switches are electrically connected to the fuel LP warning indicator on the Flight Engineer/Second Officers FUEL SYSTEM panel, zone 215.

2. Operation

When aircraft 28V dc supply is turned on, with the engine stationary, the fuel LP warning switch contacts remain closed and the applicable amber FUEL PRESSURE indicator light (Ref. Fig. 1) comes on. During engine starting, LP fuel pressure increases until, at a predetermined pressure, the LP warning switch contacts open and the warning light goes off.

During normal engine running the fuel filter differential pressure switch contacts remain open and the warning light is off. If, however, the differential pressure across the filter increases above a predetermined value, the contacts close and the warning light comes on.

3. Fuel Low-pressure Warning Switch

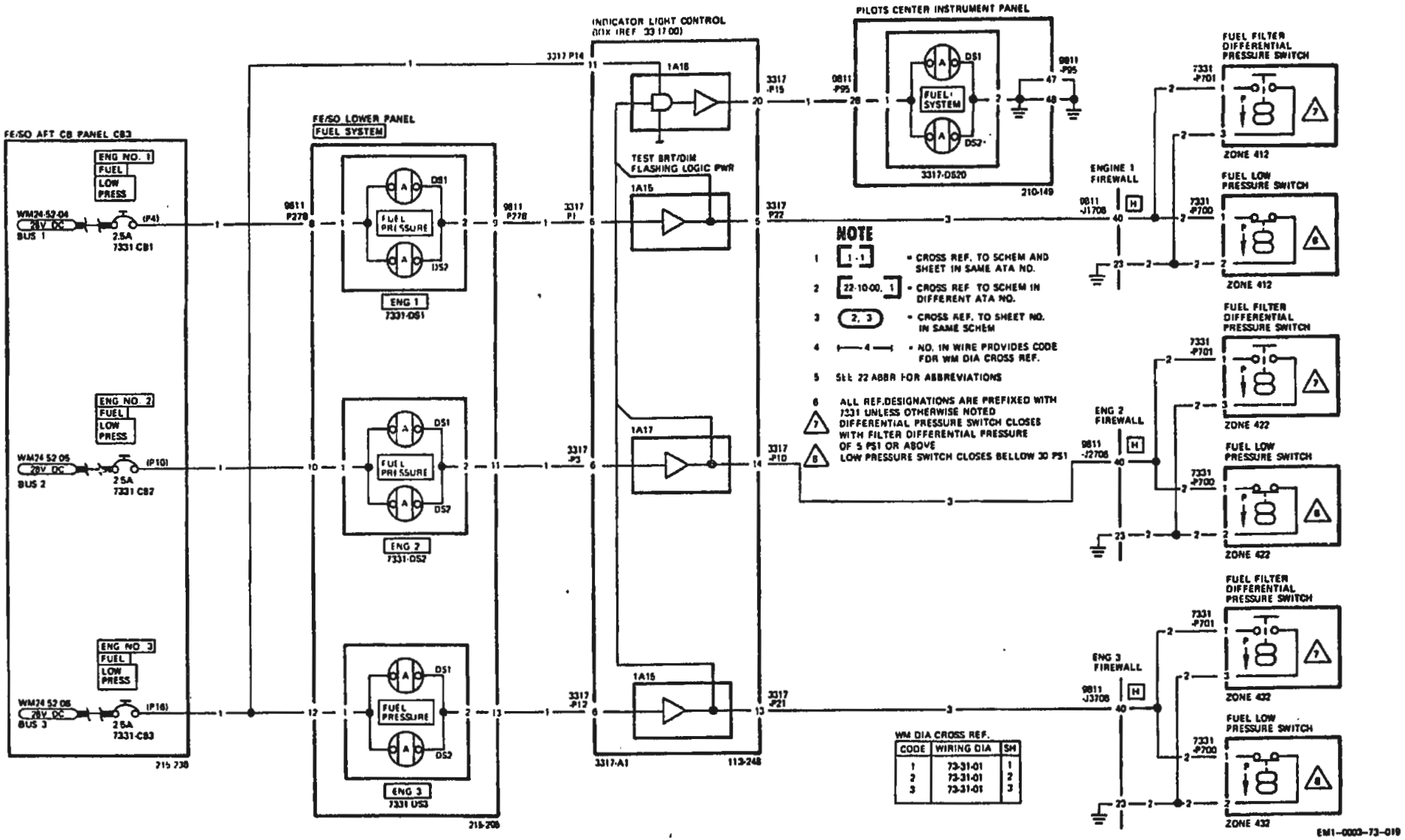
A. Description and Operation

The fuel low-pressure (LP) warning switch (Ref. Fig. 2), zones 412, 422, and 432, is positioned on the LP fuel filter housing. The switch consists basically of a metal body, that houses an electrical switch and connector, and a pressure-sensing bellows to which LP fuel is supplied internally. Expansion of the bellows is opposed by a snap-action spring which prevents the bellows actuating the switch until a predetermined pressure is reached. An increase in fuel pressure above the predetermined value expands the bellows to actuate the switch and break the circuit to the warning light. A decrease in fuel pressure below the predetermined value allows the spring to return to its normal position and the switch closes to complete the circuit to the warning light.

4. Fuel Filter Differential Pressure Switch

A. Description and Operation

The fuel filter differential pressure switches, zones 412, 422, and 432, are positioned on each low-pressure (LP) fuel filter housing. The switch consists basically of a metal body that houses an electrical switch and connector, and a pressure-sensing bellows to which low-pressure fuel is supplied through two holes in the mounting base. Fuel from the filter inlet is supplied to the inside of the bellows and fuel from the filter outlet is supplied to the chamber surrounding the bellows. Expansion of the bellows is opposed by a snap-action spring which prevents the bellows filter inlet pressure actuating the switch until a predetermined fuel pressure differential is reached. An increase in filter inlet pressure expands the bellows and at the predetermined pressure differential the switch is actuated to complete the circuit to the warning light.

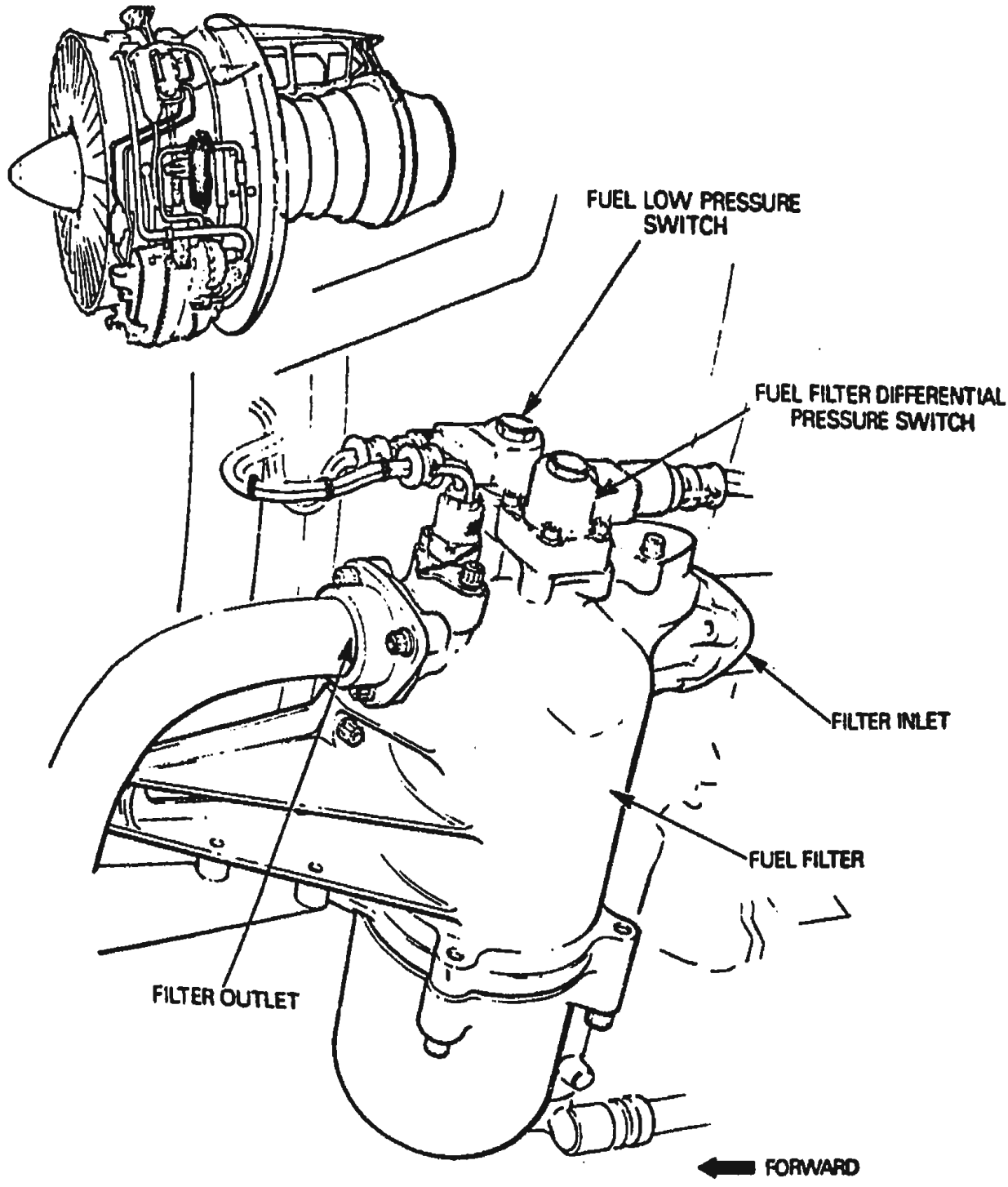


R
R

Fuel Pressure Schematic
Figure 1

EFFECTIVITY: ALL

001B



HA 2430
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Fuel Pressure Engine Units
Figure 2

R # FUEL PRESSURE SYSTEM - FAULT ISOLATION

R 1. General

R The fault isolation diagrams in this section can be used for fault isolation any time a fault is reported or suspected. Before fault isolation is started, the PREREQUISITES listed on the diagram must be fulfilled.

R If the flight crew reports a trouble using a FIRM Fault Code number, the number can be found in the FIRM Fault Code Cross Reference Table in the Chapter 73-INDEX.

R The FIRM Fault Code Cross Reference Table includes the flight report (fault symptoms) and the exact Section, Figure, Sheet, and Block number where fault isolation should begin. (Refer to the L-1011 Maintenance Manual Introduction for a more detailed explanation on the use of fault isolation diagrams.)

R 2. Fault Isolation/Identification

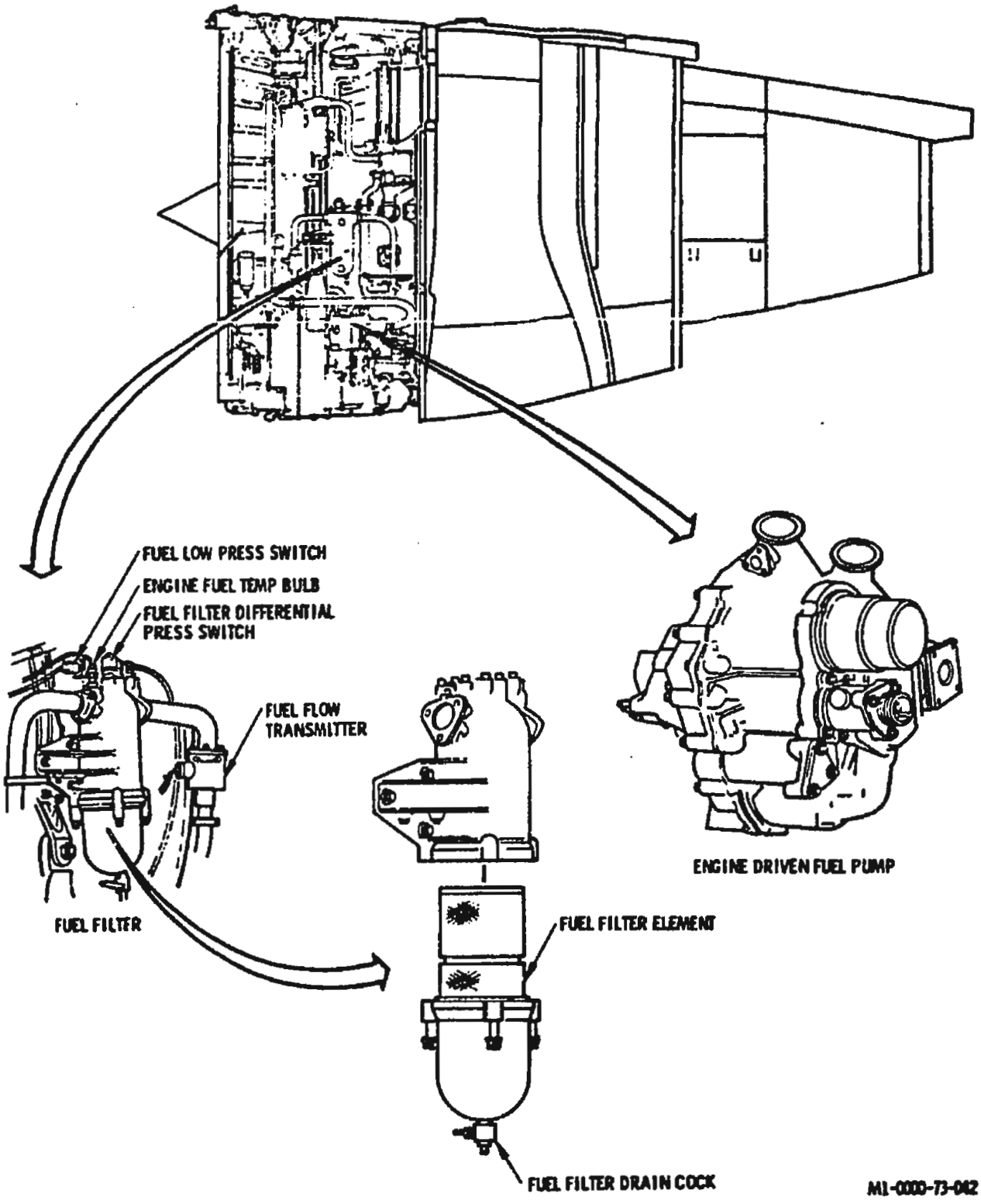
R Table 101 lists the fault isolation diagrams and schematics in this section.

R Fault Isolation Data
R Table 101

FIGURE	TITLE
101	Component Location Index
102	Components Locator
103	Fuel Low-pressure Light
SCHEM 1	Fuel Pressure System

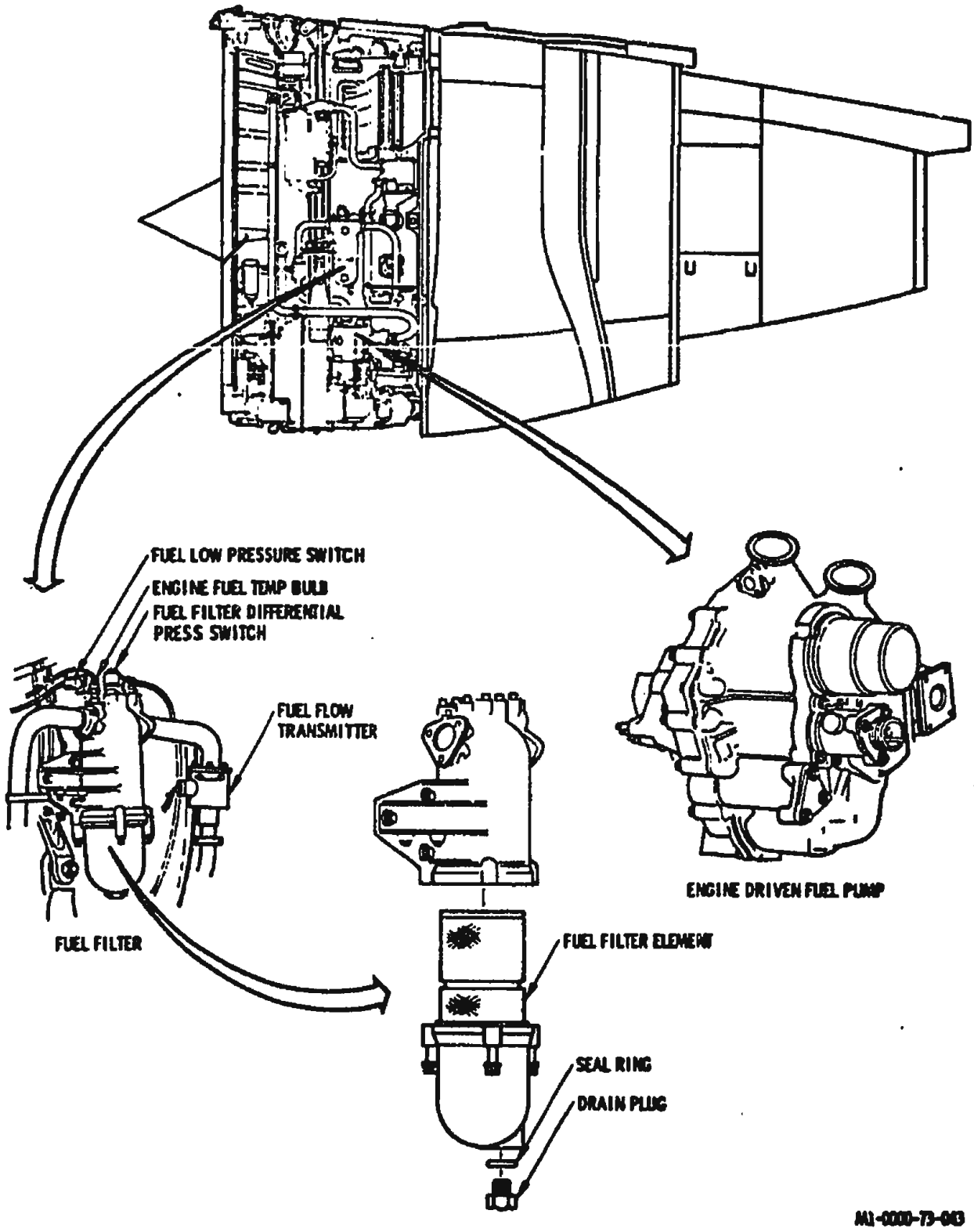
COMPONENT	QTY	AREA/ACCESS	REFERENCE
ENGINE DRIVEN FUEL PUMP:			
WING ENG	2	ACCESSORY SECTION, LH HINGED COWL	73-11-01
NO. 2 ENG	1	ACCESSORY SECTION, LH LOWER HINGED COWL	73-11-01
FILTER DIFFERENTIAL PRESSURE SWITCH:			
WING ENG	2	ACCESSORY SECTION, LH HINGED COWL	73-31-02
NO. 2 ENG	1	ACCESSORY SECTION, LH UPPER HINGED COWL	73-31-02
FUEL FILTER ELEMENT:			
WING ENG	2	ACCESSORY SECTION, LH HINGED COWL	73-11-02
NO. 2 ENG	1	ACCESSORY SECTION, LH LOWER HINGED COWL	73-11-02
FUEL LOW PRESSURE SWITCH			
WING ENG	2	ACCESSORY SECTION, LH HINGED COWL	73-31-01
NO. 2 ENG	1	ACCESSORY SECTION, LH UPPER HINGED COWL	73-31-01

M1-0000-73-045



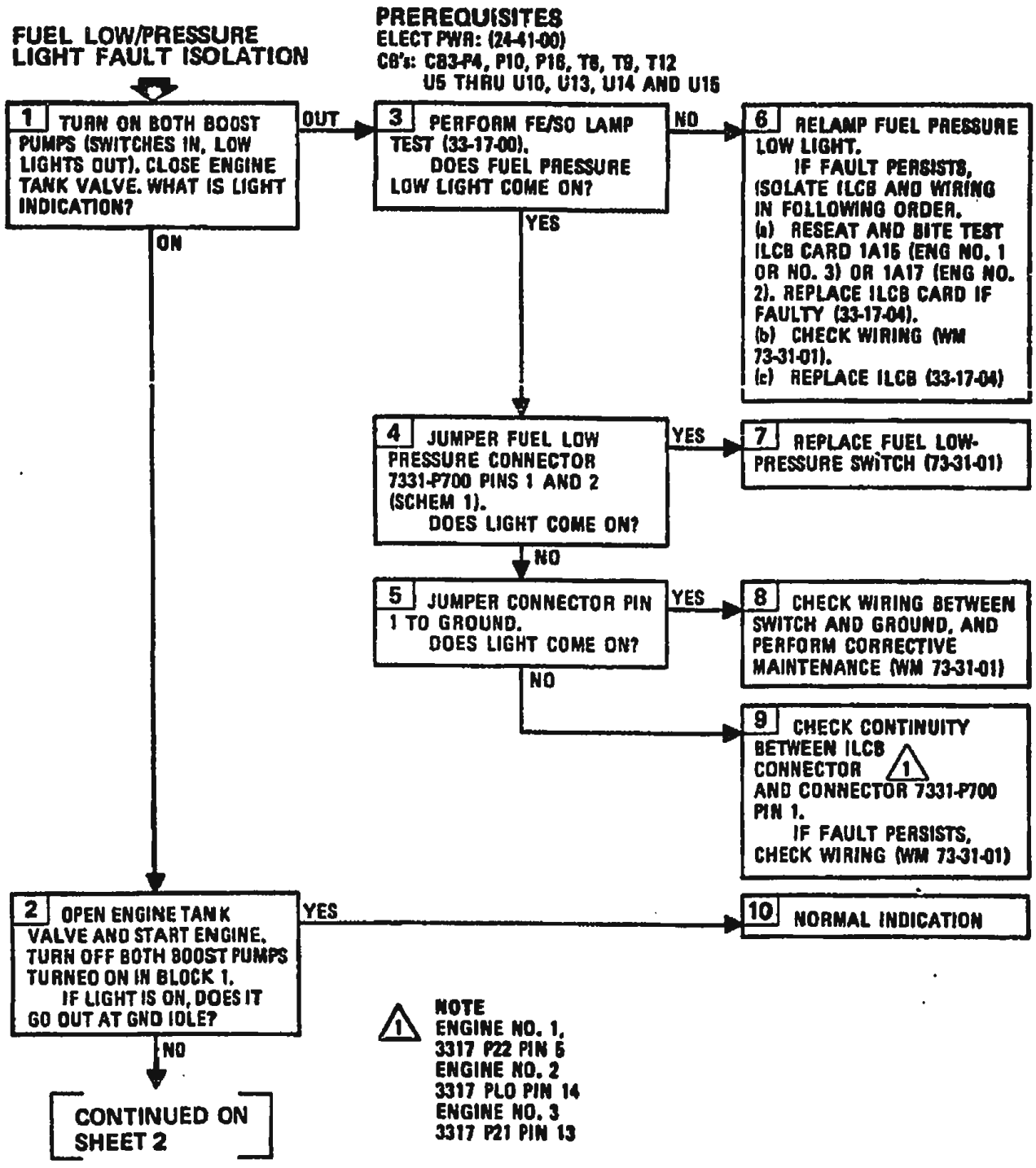
R R Fuel Pressure System Fault Isolation Component Locator
Figure 102

R R 001B EFFECTIVITY: ENGINES WITHOUT RR SB73-4473



R R Fuel Pressure System Fault Isolation Component Locator
Figure 102

R R 001B EFFECTIVITY: ENGINES WITH RR SB73-4473


FUEL LOW/PRESSURE LIGHT FAULT ISOLATION
PREREQUISITES
ELECT PWR: (24-41-00)
CB's: CB3-P4, P10, P16, T8, T9, T12
U5 THRU U10, U13, U14 AND U15
1 TURN ON BOTH BOOST PUMPS (SWITCHES IN, LOW LIGHTS OUT). CLOSE ENGINE TANK VALVE. WHAT IS LIGHT INDICATION?
OUT
ON
2 OPEN ENGINE TANK VALVE AND START ENGINE. TURN OFF BOTH BOOST PUMPS TURNED ON IN BLOCK 1.
IF LIGHT IS ON, DOES IT GO OUT AT GND IDLE?
YES
NO
CONTINUED ON SHEET 2
3 PERFORM FE/SO LAMP TEST (33-17-00).
DOES FUEL PRESSURE LOW LIGHT COME ON?
NO
YES
4 JUMPER FUEL LOW PRESSURE CONNECTOR 7331-P700 PINS 1 AND 2 (SCHEM 1).
DOES LIGHT COME ON?
YES
NO
5 JUMPER CONNECTOR PIN 1 TO GROUND.
DOES LIGHT COME ON?
YES
NO
6 RELAMP FUEL PRESSURE LOW LIGHT.
IF FAULT PERSISTS, ISOLATE ILCB AND WIRING IN FOLLOWING ORDER.
(a) RESEAT AND BITE TEST ILCB CARD 1A15 (ENG NO. 1 OR NO. 3) OR 1A17 (ENG NO. 2). REPLACE ILCB CARD IF FAULTY (33-17-04).
(b) CHECK WIRING (WM 73-31-01).
(c) REPLACE ILCB (33-17-04)
7 REPLACE FUEL LOW-PRESSURE SWITCH (73-31-01)
8 CHECK WIRING BETWEEN SWITCH AND GROUND, AND PERFORM CORRECTIVE MAINTENANCE (WM 73-31-01)
9 CHECK CONTINUITY BETWEEN ILCB CONNECTOR 1 AND CONNECTOR 7331-P700 PIN 1.
IF FAULT PERSISTS, CHECK WIRING (WM 73-31-01)
10 NORMAL INDICATION
1 NOTE
ENGINE NO. 1,
3317 P22 PIN 5
ENGINE NO. 2
3317 PL0 PIN 14
ENGINE NO. 3
3317 P21 PIN 13

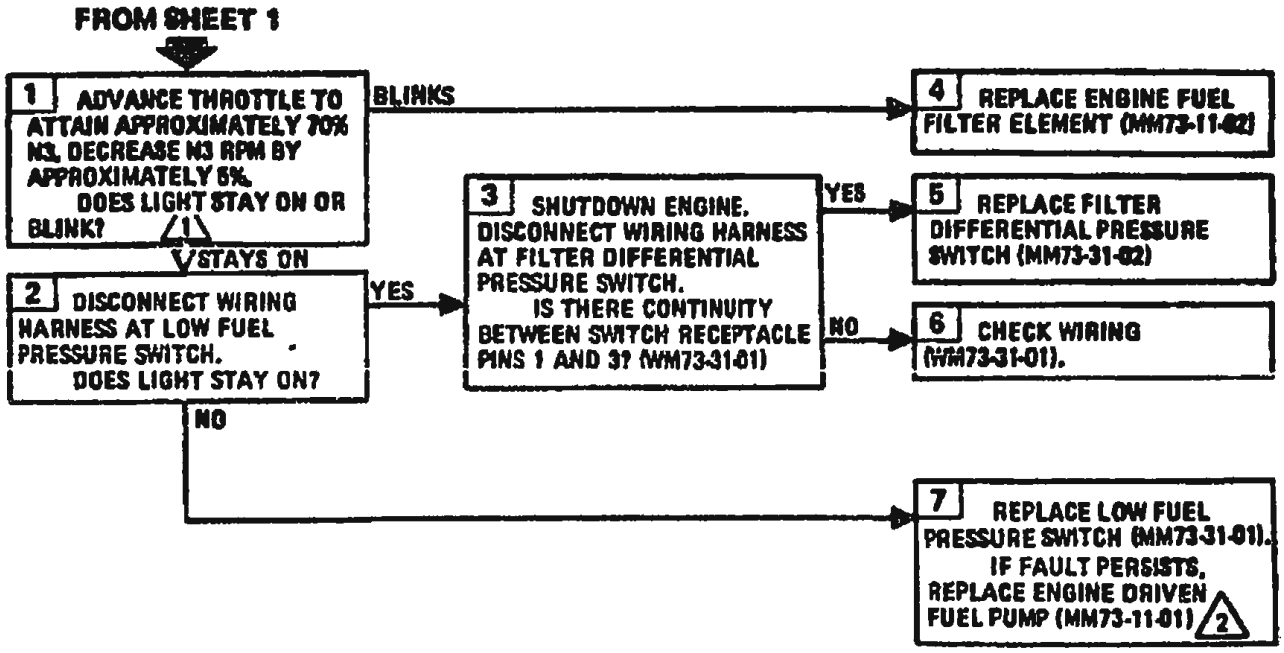
M1-0014-73 101

R Fuel Low-pressure Light
R Figure 103 (Sheet 1)

EFFECTIVITY: ALL

001B

PREREQUISITES
NONE


FROM SHEET 1
1 ADVANCE THROTTLE TO ATTAIN APPROXIMATELY 70% N3, DECREASE N3 RPM BY APPROXIMATELY 5%. DOES LIGHT STAY ON OR BLINK? 1
BLINKS
4 REPLACE ENGINE FUEL FILTER ELEMENT (MM73-11-02)
STAYS ON
2 DISCONNECT WIRING HARNESS AT LOW FUEL PRESSURE SWITCH. DOES LIGHT STAY ON?
YES
3 SHUTDOWN ENGINE. DISCONNECT WIRING HARNESS AT FILTER DIFFERENTIAL PRESSURE SWITCH. IS THERE CONTINUITY BETWEEN SWITCH RECEPTACLE PINS 1 AND 3? (MM73-31-01)
YES
5 REPLACE FILTER DIFFERENTIAL PRESSURE SWITCH (MM73-31-02)
NO
6 CHECK WIRING (MM73-31-01).
NO
7 REPLACE LOW FUEL PRESSURE SWITCH (MM73-31-01). IF FAULT PERSISTS, REPLACE ENGINE DRIVEN FUEL PUMP (MM73-11-01) 2

1 **NOTE**
DECREASING THE ENGINE RPM WILL CAUSE A MOMENTARY DECREASE IN DIFFERENTIAL PRESSURE ACROSS THE FUEL FILTER. IF THE FUEL PRESSURE LIGHT BLINKS, THE FUEL FILTER IS CLOGGED. IF THE FUEL PRESSURE LIGHT REMAINS ON, THE LOW PRESSURE ENGINE-DRIVEN PUMP HAS FAILED.

2 IF ON UNIT REMOVAL THE FUEL SYSTEM IS FOUND TO BE CONTAMINATED BY METAL OR OTHER FOREIGN DEBRIS THE FUEL FILTER IN H. P. FUEL TUBE TO FUEL SPRAY NOZZLE MANIFOLD (REF. MM73-11-09, REMOVAL/INSTALLATION) AND FUEL COOLED OIL COOLER (REF. MM79-21-04 MAINTENANCE PRACTICES) MUST BE REPLACED WITHIN 750 HOURS.

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R
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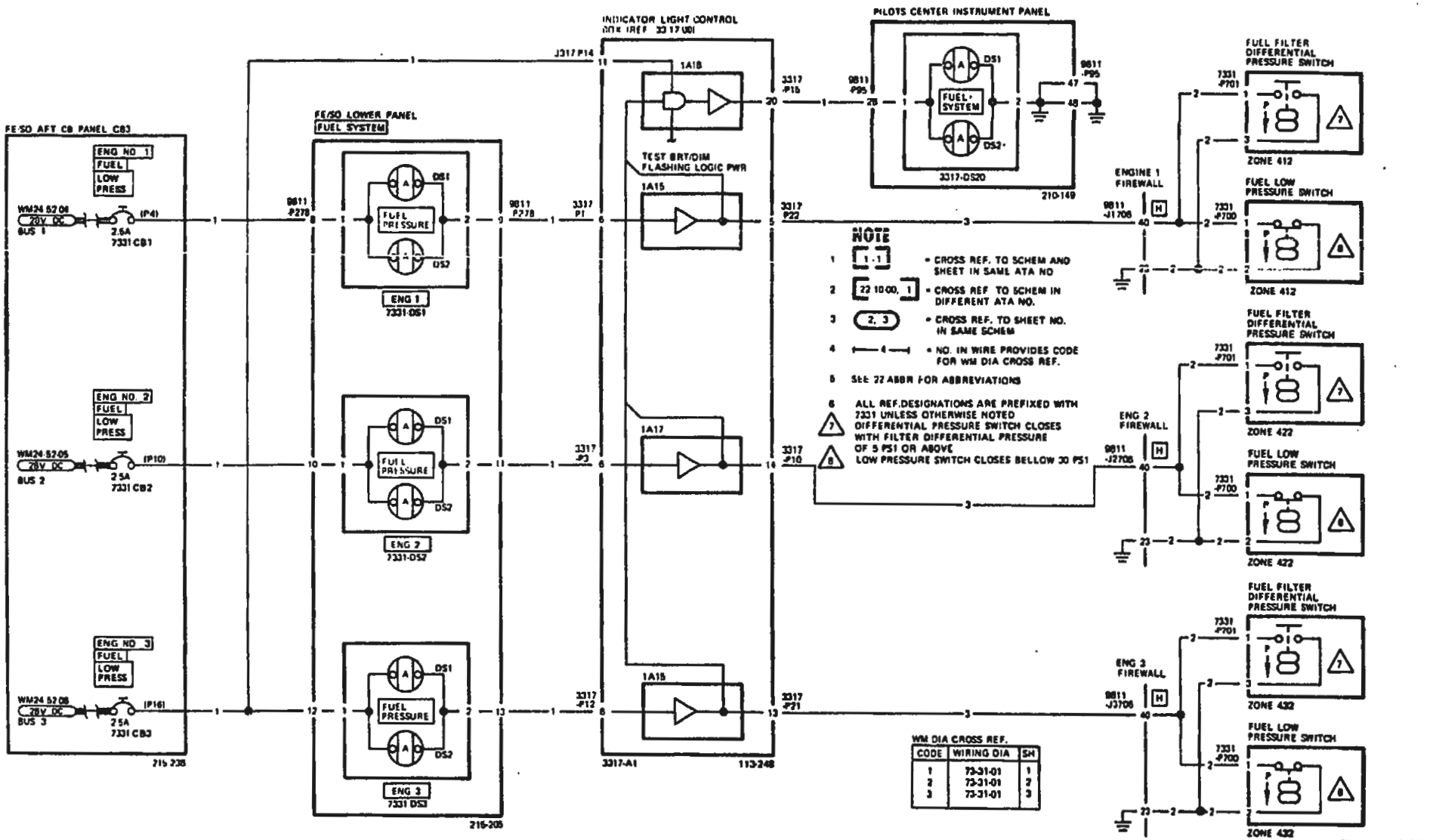
Fuel Low-pressure Light
Figure 103 (Sheet 2)



R
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Fuel Pressure System
SCHEM 1

EFFECTIVITY: ALL

001B

FUEL PRESSURE SYSTEM - MAINTENANCE PRACTICES

1. Deactivation

NOTE: *This deactivation procedure applies only when an aircraft is to be dispatched in accordance with the MEL.*

If the aircraft is to be operated with an inoperative fuel pressure warning system, the fuel filter element must be replaced to ensure proper filter operation (Ref. 73-11-02).

2. Verification

It may be necessary to install a known operative fuel low pressure switch P/N 21SN04-25C to satisfactorily accomplish test No. 19 of MM 71-00-00

CR NOTE: Test 19A (Alternate Procedure L.P. Fuel Pump Drive Test) of MM 71-00-00 may be substituted. This procedure measures pressure output and does not require using an operative fuel low pressure switch.

Make appropriate entry in aircraft log book.

C 3. Engine Fuel Pressure Light

C A. Several delays have been caused by a misunderstanding of the purpose of the "Engine Fuel Pressure Light". The ENGINE FUEL PRESSURE light on the Flight engineer's lower instrument panel indicates that the primary section of the engine driven fuel pump is working.

C B. During preflight the fuel tank boost pump is turned on and the pump low pressure light, on the boost pump switch, will go out at about 6 PSI. In most cases the pump will put out more than the 30 PSI necessary to extinguish the ENGINE FUEL PRESSURE light, but if it does not, it is not an indication that there is a malfunction in the system. Due to varying pump outputs and system internal leakage, the electric fuel boost pumps may not produce the 30 PSI required to extinguish the Engine Fuel Pressure Light. The fuel tank boost pump is normally shop checked for a minimum of 26 PSI. If the "Engine Fuel Pressure Light" remains on with the boost pump on, start the engine (primary stage pressure approximately 55 PSI) and the light will go out.

C C. Remember that positive electric boost pump pressure is indicated when the light in the pump switch is extinguished

C and that engine fuel pressure extinguishes the ENGINE FUEL
C PRESSURE LIGHT located on the Flight Engineer's lower
C instrument panel.

FUEL PRESSURE SYSTEM - ADJUSTMENT AND TEST

1. Referenced Procedure

   24-41-00 External Power/Ground Service System - Maintenance Practices

2. Adjustment/Test

   A. Fuel Low-pressure Warning System Operational Test

      (1) Turn on External power (Ref. 24-41-00).

      (2) Check that fuel low-pressure warning indicator FUEL PRESSURE light comes on.

      (3) Turn off external power (Ref. 24-41-00).

      (4) Before next flight, during engine start, check that applicable engine fuel low-pressure warning indicator light goes out when engine reaches ground idle.

      (5) On engine shutdown, check that applicable engine low-pressure indicator light comes on.

FUEL LOW-PRESSURE WARNING SWITCH - REMOVAL AND INSTALLATION

1. Equipment and Materials

Protective caps and plugs

Container (minimum capacity: 5 U.S. gallons, 4 Imperial gallons, or 18 liters).

Flexible hose: approximate length of 72 in. (1800 mm) and ID of 0.5 in. (12 mm)

2. Referenced Procedures

	24-41-00	Electrical Power/Ground Service System - Maintenance Practices
	70-02-01	Lubrication and Fitting of Rubber Seal Rings Identification
R	71-11-00	Left-hand Hinged Cowl - Servicing
	71-12-01	LH and RH Lower Hinged Cowl - Servicing
	73-00-00	Engine Fuel and Control - Servicing
	73-00-00	Engine Fuel and Control - Adjustment and Test
	73-11-02	Low-pressure Fuel Filter - Maintenance Practices
	73-31-00	Fuel Pressure System - Adjustment and Test

3. Removal/Installation

A. Removal

(1) Close applicable engine fuel firewall shutoff valve as follows:

(a) Turn on electrical power (Ref. 24-41-00).

(b) On pilots overhead panel, zone 210, pull and tag applicable FIRE PULL handle.

(c) Turn off electrical power.

(2) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag applicable circuit breaker FUEL LOW PRESS (P4, P10, or P16).

(3) Open applicable LH hinged cowl, 413A or 423A for engine No. 1 or 3 (Ref. 71-11-00), or 433DL for engine No. 2 (Ref. 71-12-01).

(4) Drain low-pressure fuel filter (Ref. 73-11-02).

CAUTION: ENSURE CONNECTION IS FREE FROM LIQUID AND/OR SOLID CONTAMINATION BEFORE DISCONNECTING.

(5) Disconnect the low-pressure switch electrical connector (Ref. Fig. 401).

R (6) On engines without RR SB71-2388,
R remove securing bolts.

R (6) On engines with RR SB71-2388,
R remove securing bolts and move bracket clear of switch.

(7) Lift pressure switch from fuel filter to clear dowel then remove switch.

R (8) Remove retaining ring and seal ring from pressure
R switch. Discard seal ring.

R (9) Install caps or plugs on all exposed openings and electrical connector.

B. Installation

(1) Verify the following:

(a) FIRE PULL handle pulled in Step 3A(1) is pulled and tagged.

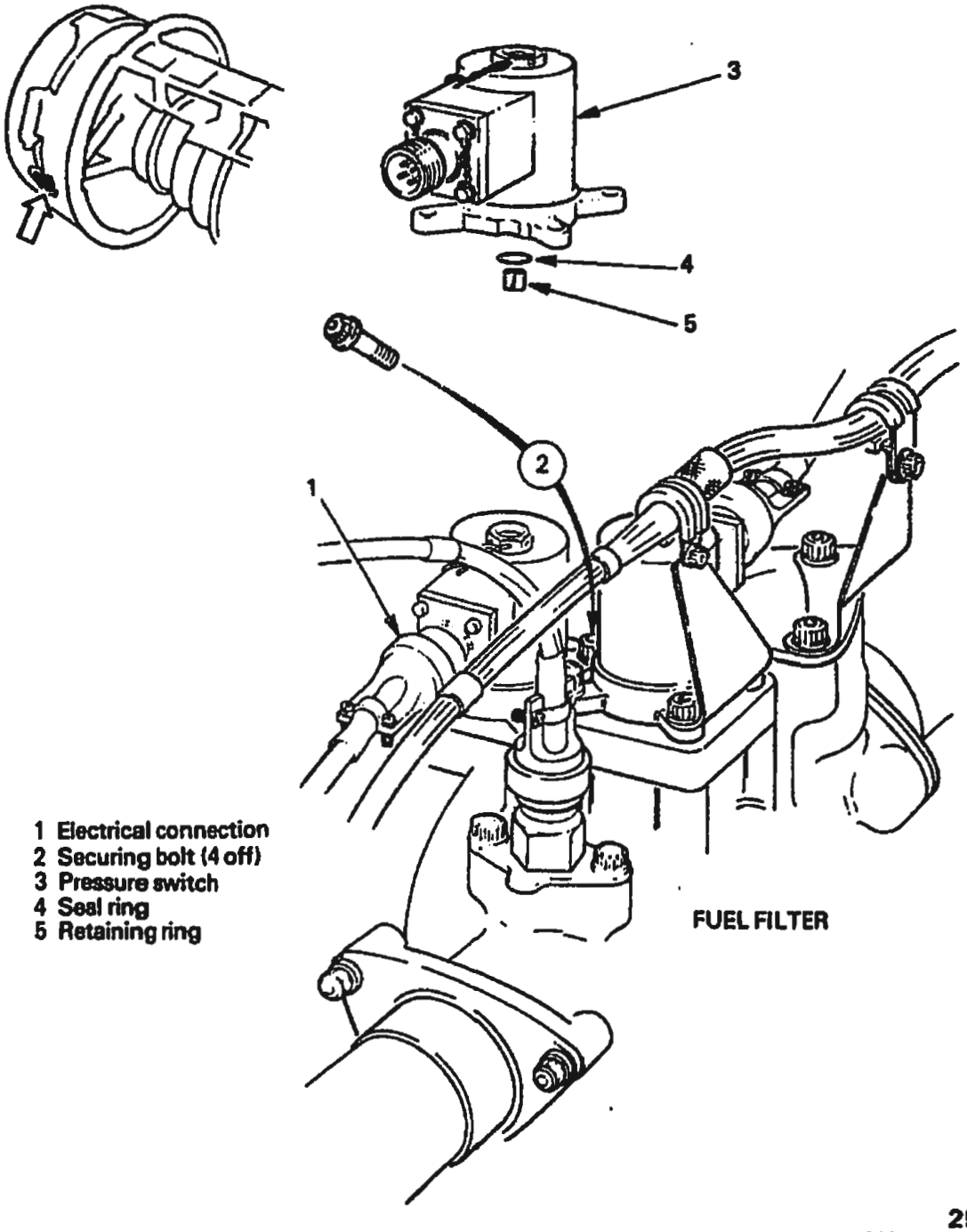
(b) Circuit breaker opened in Step 3A(2) is open and tagged.

(2) Remove caps or plugs from electrical connector (Ref. Fig. 401) and all openings.

(3) Ensure that fuel filter mounting face is clean and undamaged.

R (4) Install and lubricate a new seal ring and retaining
R ring in pressure switch.

R (5) On engines without RR SB71-2388,
R install pressure switch on mounting face, ensuring

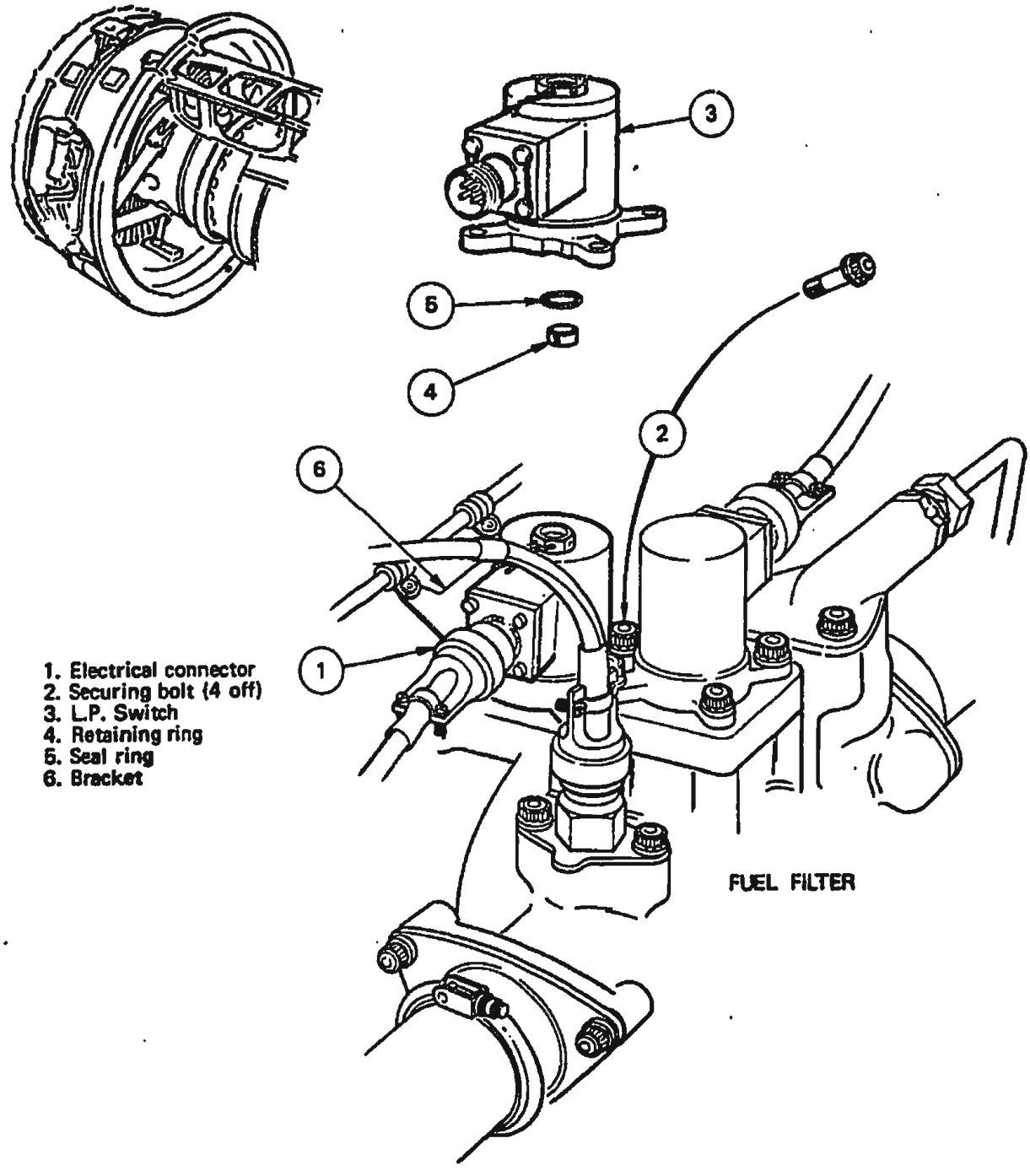


25464B
M1-0001-73-091

R Fuel Low-pressure Warning Switch - Removal and Installation
R Figure 401

EFFECTIVITY: ENGINES WITHOUT RR SB71-2388

001B



35403
M1-0100-73-038

Fuel Low-pressure Warning Switch - Removal and Installation
Figure 401

R R positive location on dowel and secure with securing bolts.

R R R (5) On engines with RR SB71-2388, install pressure switch, position harness bracket, and secure with bolts.

(6) Connect and secure electrical connector.

(7) Remove tag and close circuit breaker opened in Step 3A(2), then close applicable engine fuel firewall shutoff valve as follows:

(a) Turn on electrical power (Ref. 24-41-00).

(b) Remove tag and push in applicable FIRE PULL handle.

(c) Turn off electrical power.

(8) Prime low-pressure fuel system (Ref. 73-00-00, Servicing).

(9) Test pressure switch operation (Ref. 73-31-00).

(10) Test for leaks at points disturbed (Ref. 73-00-00, Adjustment and Test).

(11) Close applicable LH hinged cowl.

FUEL FILTER DIFFERENTIAL PRESSURE SWITCH REMOVAL AND INSTALLATION

1. Equipment and Materials

Container (minimum capacity: 5 U.S. gallons, 4 Imperial gallons, or 18 liters)

Flexible hose: approximate length of 72 in. (1800 mm) and ID of 0.5 in. (12 mm)

2. Referenced Procedures

24-41-00	Electrical Power/Ground Service System - Maintenance Practices
70-02-01	Lubrication and Fitting of Rubber Seal Rings Identification
71-11-00	LH Hinged Cowl - Servicing
71-12-01	LH and RH Lower Hinged Cowls - Servicing
73-00-00	Engine Fuel and Control - Servicing
73-00-00	Engine Fuel and Control - Adjustment and Test
73-11-02	Low-pressure Fuel Filter - Maintenance Practices

3. Removal/Installation

A. Removal

(1) Close applicable engine fuel firewall shutoff valve as follows:

(a) Turn on electrical power (Ref. 24-41-00).

(b) On pilots overhead panel, zone 210, pull and tag applicable FIRE PULL handle.

(c) Turn off electrical power.

(2) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag applicable circuit breaker FUEL LOW PRESS (P4, P10, or P16).

(3) Open applicable LH hinged cowl, 413A or 423A for engine No. 1 or No. 3 (Ref. 71-11-00) or 433DL for engine No. 2 (Ref. 71-12-01).

(4) Drain low-pressure fuel filter (Ref. 73-11-02).

(5) Disconnect the differential-pressure switch electrical connector (Ref. Fig. 401).

(6) On engines without RR SB71-2388, remove securing bolts and move bracket clear of switch.

(6) On engines with RR SB71-2388, remove securing bolts.

(7) Lift differential-pressure switch to clear dowel then remove switch from crossover plate.

(8) Remove retaining rings and seal rings from pressure switch. Discard seal rings.

(9) Lift crossover plate to clear dowel then remove crossover plate from fuel filter.

(10) Remove retaining rings and seal rings from fuel filter. Discard seal rings.

(11) Install approved blanks to all exposed apertures and electrical connector.

B. Installation

(1) Verify the following:

(a) FIRE PULL handle pulled in Step 3A(1) is pulled and tagged.

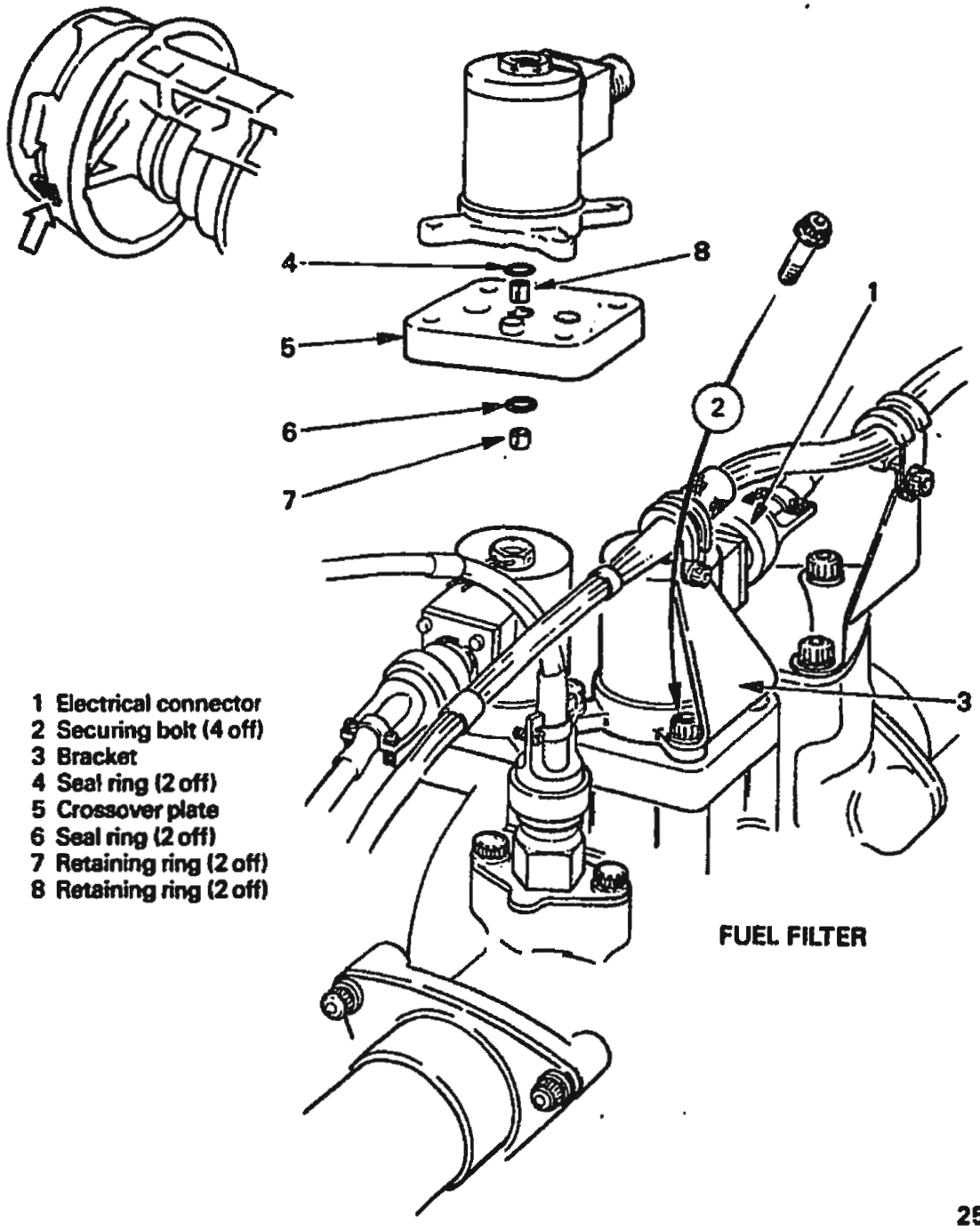
(b) Circuit breaker opened in Step 3A(2) is open and tagged.

(2) Remove blanks from electrical connector (Ref. Fig. 401) and all apertures.

(3) Ensure that fuel filter mounting face and crossover plate are clean and undamaged.

(4) Install and lubricate new seal rings and retaining rings (Ref. 70-02-01) in recesses in filter mounting face.

(5) Install crossover plate on mounting face (Ref. Fig. 1) ensuring positive location on dowel.



1 Electrical connector
2 Securing bolt (4 off)
3 Bracket
4 Seal ring (2 off)
5 Crossover plate
6 Seal ring (2 off)
7 Retaining ring (2 off)
8 Retaining ring (2 off)

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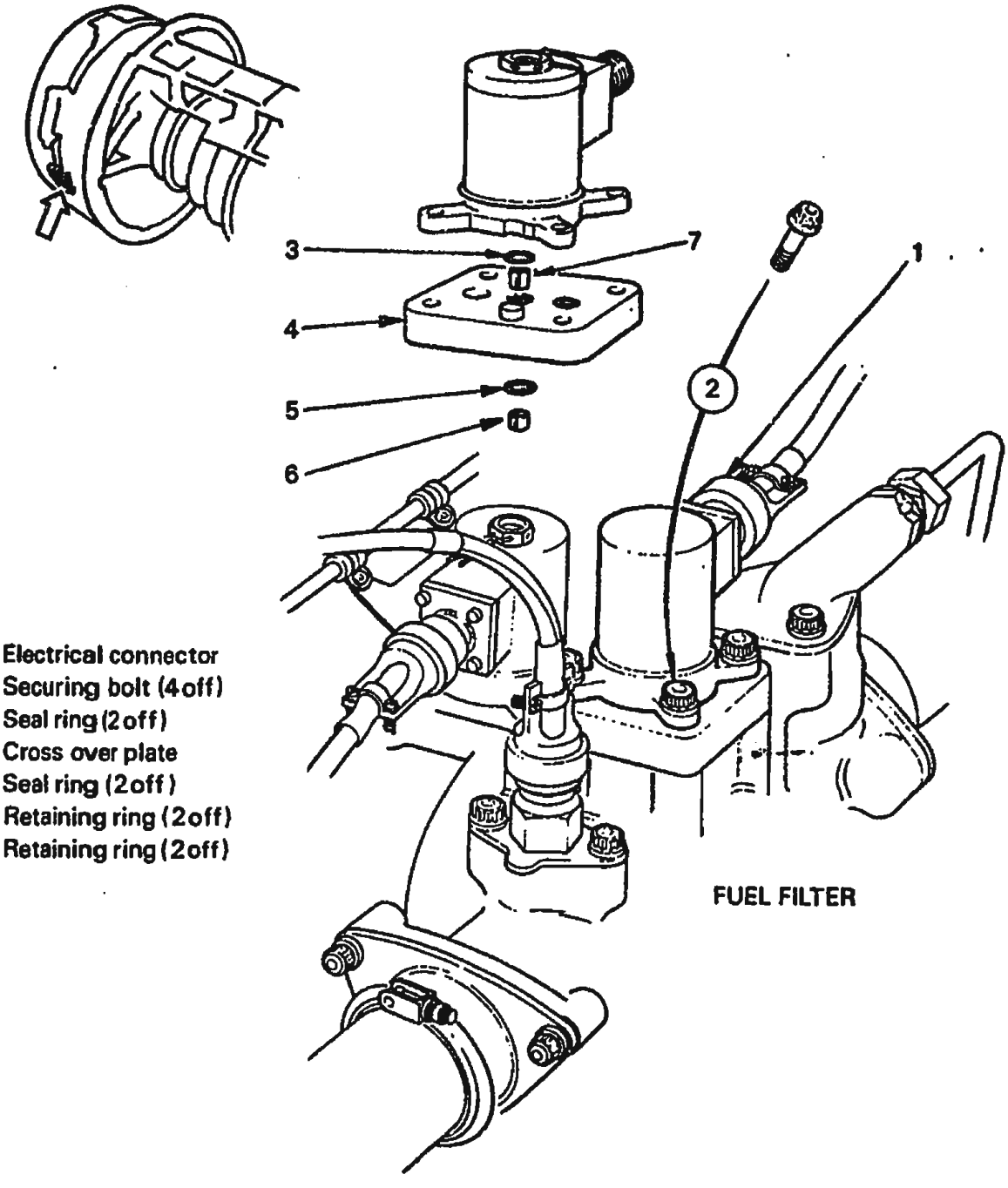
M1-0002-73-401

R Fuel Filter Differential Pressure Switch
R Removal and Installation
R Figure 401

EFFECTIVITY: ENGINES WITHOUT RR SB71-2388

001B



1 Electrical connector
2 Securing bolt (4off)
3 Seal ring (2off)
4 Cross over plate
5 Seal ring (2off)
6 Retaining ring (2off)
7 Retaining ring (2off)

FUEL FILTER

90062
M1-0001-73-413

R Fuel Filter Differential Pressure Switch
R Removal and Installation
R Figure 401

EFFECTIVITY: ENGINES WITH RR SB71-2388

001B

(6) Install and lubricate new seal rings and retaining rings (Ref. 70-02-01) in recesses in pressure switch.

(7) Install differential-pressure switch (Ref. Fig. 1) on
R crossover plate ensuring positive location on dowel.

R (8) On engines without RR SB71-2388,
R install bracket on switch mounting lugs, then secure
R bracket, switch, and crossover plate with securing
R bolts.

R (8) On engines with RR SB71-2388,
R secure switch and crossover plate with bolts.

R (9) Connect and secure electrical connector.

R (10) Remove tag and close circuit breaker opened in Step
R 3A(2), then close applicable engine fuel firewall
R shutoff valve as follows:

R (a) Turn on electrical power (Ref. 24-41-00).

R (b) Remove tag and push in applicable FIRE PULL
R handle.

R (c) Turn off electrical power.

R (11) Prime low-pressure fuel system (Ref. 73-00-00,
R Servicing).

R (12) Test for leaks at points disturbed (Ref. 73-00-00,
R Adjustment and Test).

R (13) Close LH hinged cowl.

FUEL FLOW/FUEL USED SYSTEM - DESCRIPTION AND OPERATION

1. General

The engine fuel flow and fuel used indicating system provides fuel flow data to the pilots, and fuel used data to the Flight Engineer/Second Officer. The mass of fuel flowing is sensed by the fuel flow transmitter located in the fuel line between the low-pressure fuel filter and the low-pressure fuel pump, zones 412, 422, and 432. Analog readouts representing fuel flow in pounds per hour (PPH) for each engine are provided by the three-scale, vertical-tape fuel flow rate (FF) indicator on the pilots instrument panel, zone 210. A digital display of pounds of fuel consumed is provided by the FUEL USED indicator on the Flight Engineer/Second Officers ENGINE FUEL panel, zone 215.

The transmitters and indicators require 115V, 400-Hz operating power. Indicator lighting operates on 5V, 400-Hz power from the dimming control unit. Signals from the transmitter are conditioned to drive the digital fuel-used display by circuitry in that indicator (Ref. Fig. 1). The signal input to the FF indicator is derived from the FUEL USED indicator. The signal requires further conditioning in the indicator to drive the analog display of the FF indicator.

Actuation of the FUEL USED RESET guarded switchlight on the Flight Engineer/Second Officers FUEL SYSTEM panel, zone 215, resets the FUEL USED indicator digital wheels to 0.

2. Fuel Flow Transmitter

A. Description and Operation

The engine-mounted fuel flow transmitter (Ref. Fig. 2), located in zones 412, 422, and 432, is fitted in the low-pressure (LP) fuel line between the P4 fuel-cooled air cooler and the fuel filter inlet.

The transmitter is electrically connected to the fuel-used indicator, zone 215, through the engine electrical harness (Ref. 71-50-00) and the aircraft wiring. Signals for the flow rate indicator, zone 210, are provided by the fuel-used indicator.

The fuel flow transmitter measures mass of fuel flow which is independent of changes in density and viscosity. This is achieved by giving the fuel flow an angular velocity, then determining the angular momentum of the flow from which mass flow can be evaluated.

The transmitter (Ref. Fig. 2) comprises a rotor assembly, a housing assembly, and a shell assembly.

The rotor assembly consists of a cone-shaped fuel director, incorporating skewed channels, a rotor, and a turbine. The rotor and turbine are free to rotate and incorporate axial fuel passages. The assembly is supported in the housing assembly which incorporates an inlet and an outlet port, a flow straightener, and spring flow directors.

The shell assembly surrounds the housing assembly and contains an electrical receptacle, a rotor speed pick-off, a R turbine position pick-off, and an electromagnetic torquer. An arrow stamped on the shell provides indication of the correct direction of fuel flow through the transmitter.

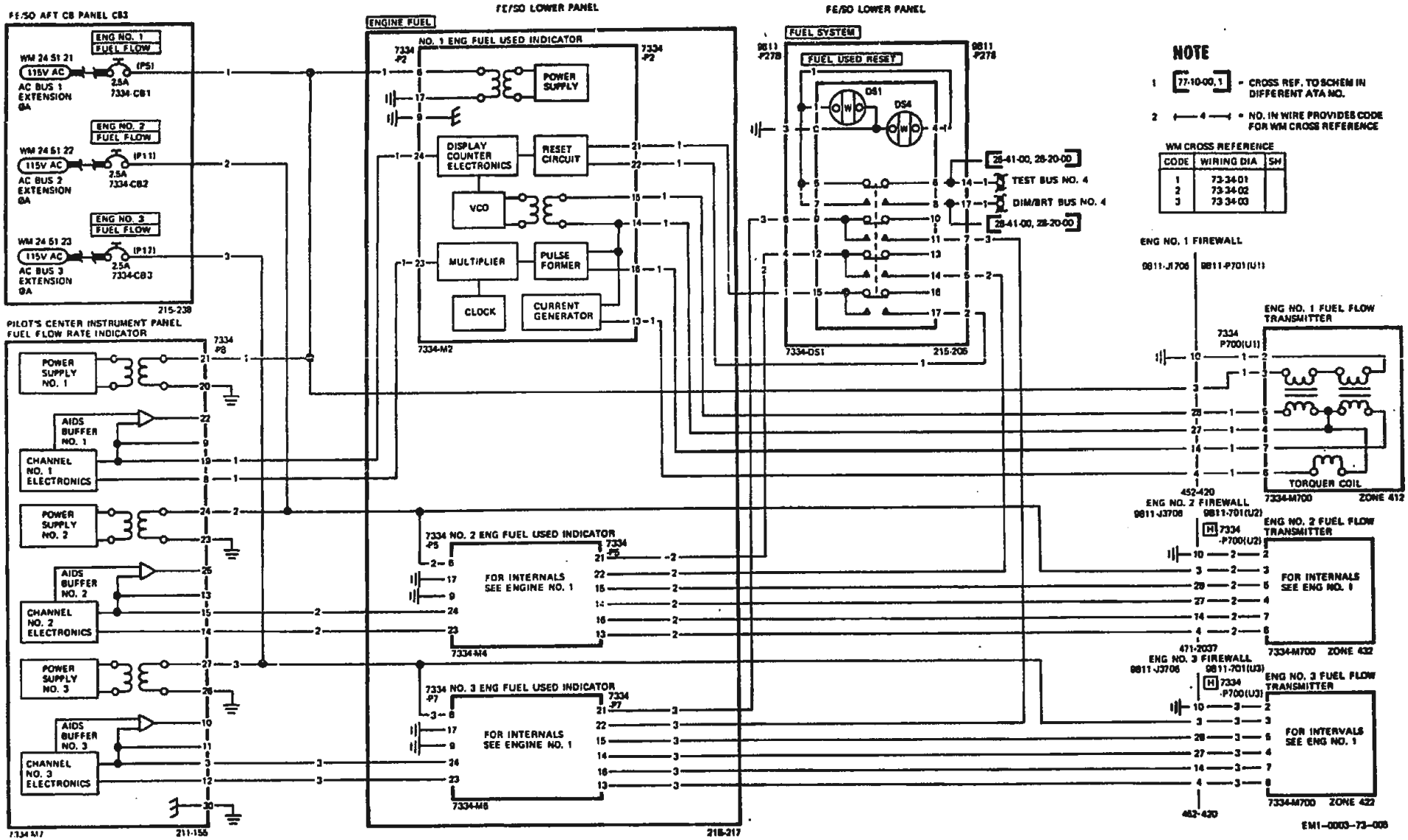
The speed pick-off measures the rotational speed of the rotor, which represents the angular velocity of the fuel leaving the rotor and entering the turbine. The position pick-off measures any deflection of the turbine caused by unbalance between the torques acting on the turbine. These R are the torques produced in absorbing the angular momentum of the fuel flowing through the turbine and the opposing torque produced by the electromagnetic torquer. The signal produced by the position pick-off represents the angular momentum of the fuel.

The speed and position pick-off electrical signals are transmitted to the fuel-used indicator system where they are processed and used to determine the value of the electrical supply required by the torquer to balance the angular momentum of the fuel.

The position pick-off signal is further processed to provide a digital display of fuel used and also the input signal for the rate-of-flow indicator.

Under steady running conditions, the angular velocity of the fuel imparted to the fuel leaving the rotor causes a steady signal to be produced by the speed pick-off. The angular momentum of the fuel absorbed by the turbine is balanced by the electromagnetic torquer, thus causing a steady signal to be produced by the position pick-off.

When fuel flow increases, rotor speed and, therefore, the angular velocity and angular momentum of the fuel increase. The increase in rotor speed causes an increase in speed pick-off signal to the fuel-used indicator. The increase in angular momentum causes the turbine to deflect from the balance position which causes an increase in position pick-off signal to the fuel-used indicator.



R Fuel Flow/Fuel Used Schematic
R Figure 1

EFFECTIVITY: ALL

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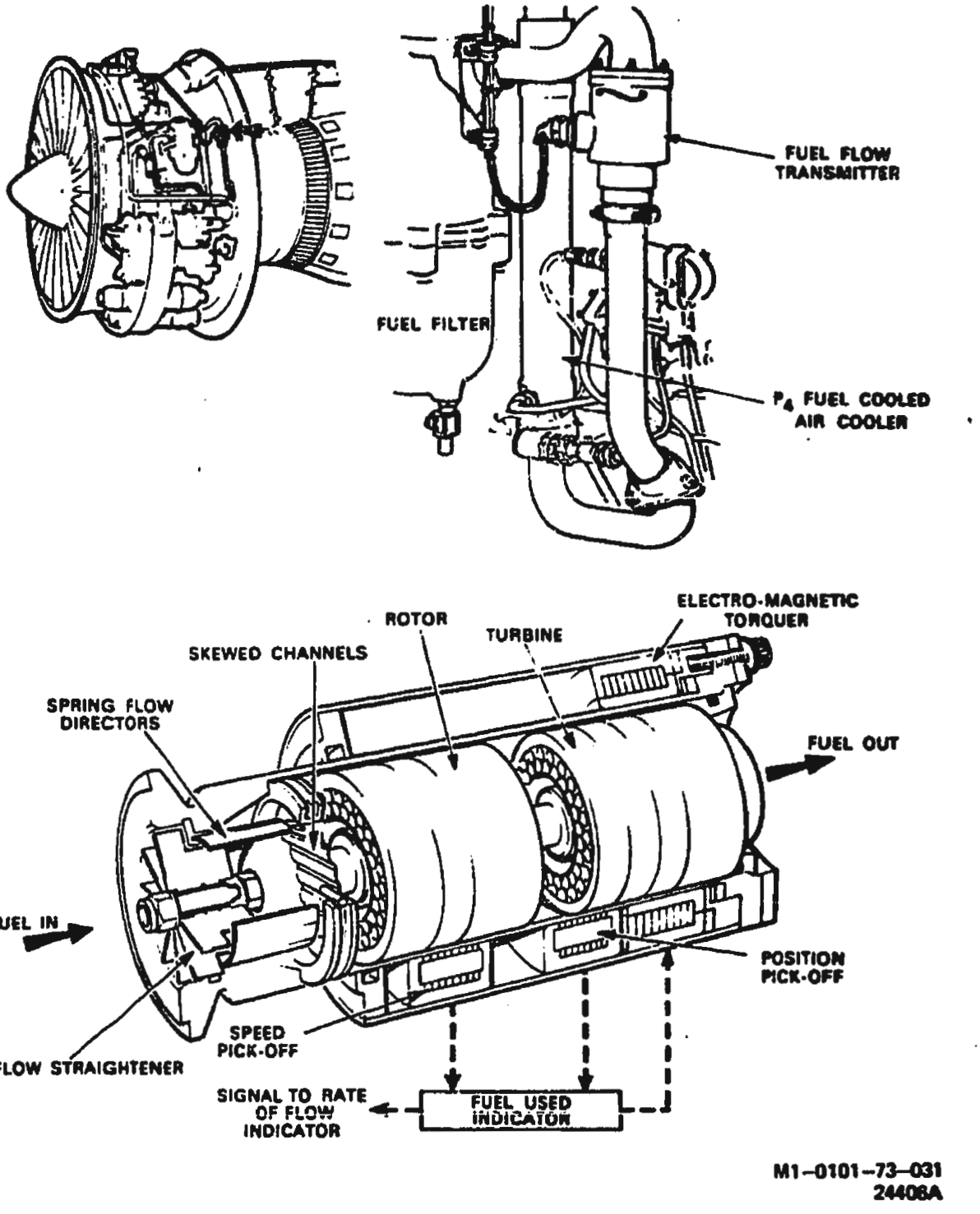


Fuel Flow Transmitter
Figure 2

The fuel-used indicator evaluates the increase in speed and position pick-off signals and increases the signal to the flow rate indicator and the power supply to the torquer. The torque produced by the torquer then increases to balance the increase in angular momentum, and a state of balance is again achieved.

If fuel flow decreases, the signals from the pick-offs decrease and the torquer power supply is correspondingly reduced until a state of balance is achieved.

3. Fuel Flow Rate Indicator

A. Description

A single three-scale, vertical-tape fuel flow rate (FF) indicator is located on the pilots instrument panel, zone 210. The three scales provide analog displays of the fuel flow rate for each engine (Ref. Fig. 3).

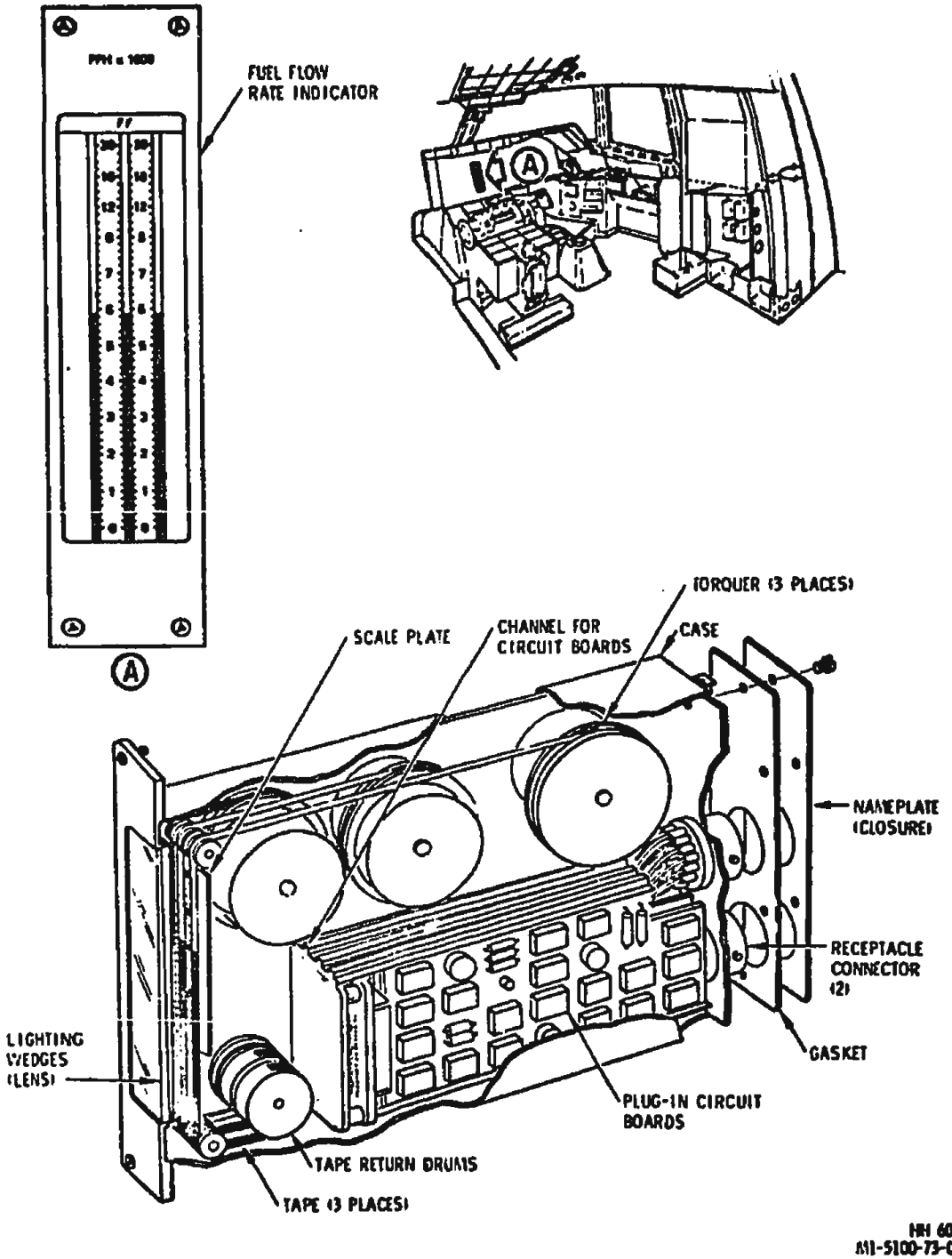
The indicator consists of a bevel-edge rectangular case, a vertical scale plate, three analog scale tapes, three dc torquers, and the electronics to condition the input signal. The displays indicate the fuel flow rate in pounds of fuel per hour.

All signal conditioning and torquer driving electronics are contained in the indicator case. Each torquer drives a woven glass tape to provide the readouts. Tapes are attached to drums mounted on the torquer shafts. Two idlers guide each tape to the 1-inch-diameter, spring-loaded tension drum located at the other end of the tape. The juncture of the white and black portions of each tape is the point at which the fixed indicating scale is read.

B. Operation

The fuel flow indicator operates on 115V, 400-Hz power. Indicator lighting requires 5V, 400-Hz power. The transmitter output is conditioned by the circuitry in the FUEL USED indicator which, in turn, provides the input signal for the FF indicator (Ref. Fig. 4). The input signal consists of a chain of pulses, whose frequency is a function of the engine fuel flow rate. The frequency is converted to a dc voltage which is amplified to operate the torquer.

A driving signal to the torquer is provided whenever the dc-amplifier output and the voltage from the wiper of the balancing potentiometer are not equal. Balancing potentiometer voltages picked off by its wiper are equal to the dc-amplifier output voltages corresponding to the



Engine Fuel Flow Rate Indicator
Figure 3

different pointer positions. Therefore, when the pointer readout and input signal are equal, there is no voltage difference available for amplification to drive the dc torquer.

4. Fuel Used Indicator

A. Description

Three FUEL USED indicators are located on the Flight Engineer/Second Officers ENGINE FUEL panel, zone 215. The indicators provide a digital display of engine fuel used (Ref. Fig. 5).

The indicator is housed in a standard No. 2 ATI case. Weight of fuel used is displayed on an odometer driven mechanically through gearing by a step motor.

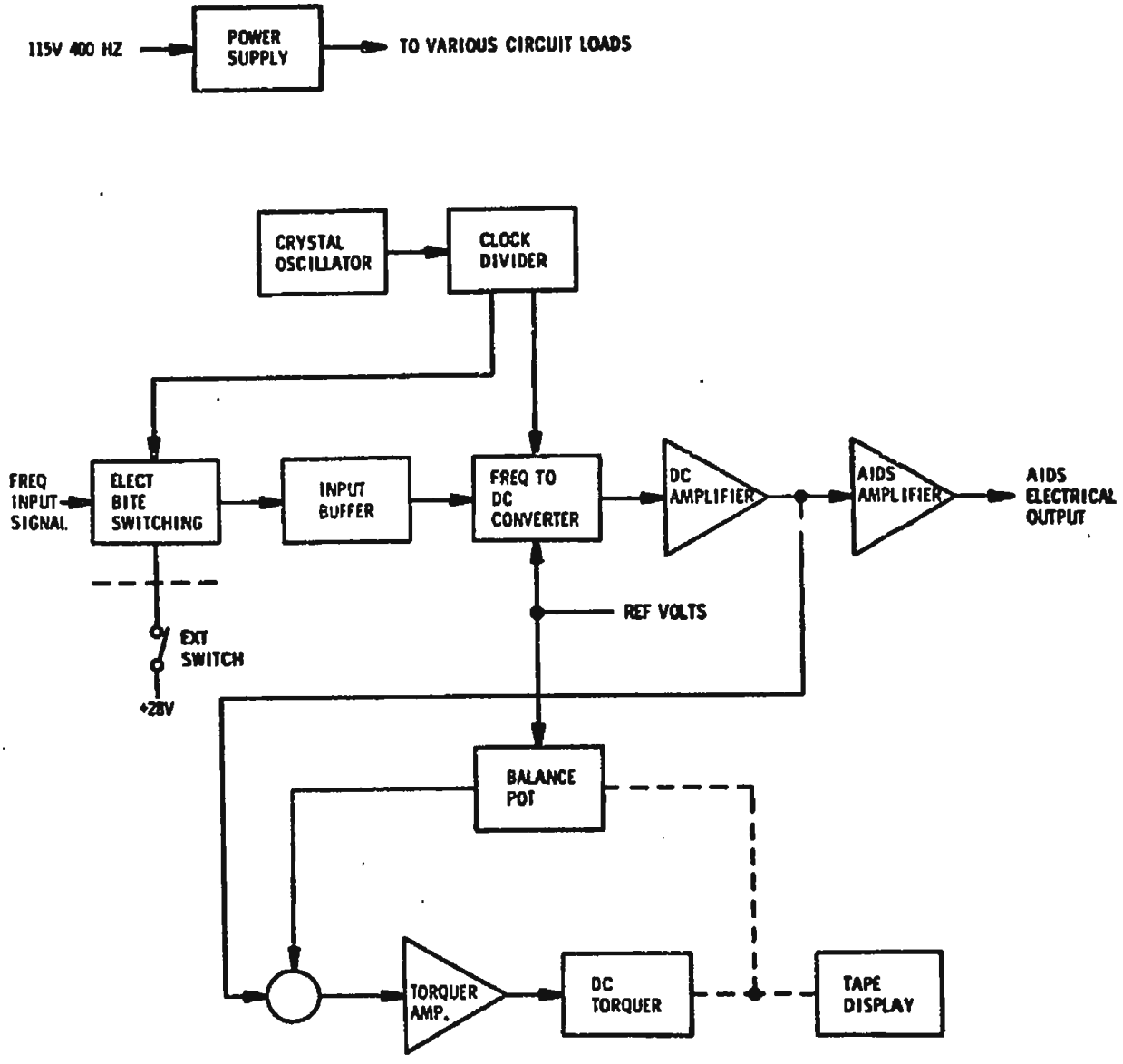
Illuminating lamps, located in the top left and right corners, are removable from the front of the indicator. A built-in-test-equipment (BITE) actuator is located in the lower left front corner of the instrument. All of the electronics to measure the transmitter output and operate the counter are contained in the case.

B. Operation

The FUEL USED indicator operates on 115V, 400-Hz power. Two signals from the transmitter determine the circuit operation (Ref. Fig. 6). The transmitter impeller speed pickoff signal defines the repetition rate of the current pulses to the transmitter torquer. The transmitter turbine position pickoff signal indicates whether the average torquer current should be increased or decreased to achieve system balance. The signals are conditioned by the circuitry in the indicator case.

The speed pickoff signal is a modulated 400-Hz voltage. The modulating frequency is a function of the transmitter impeller speed. A voltage pulse is generated by the pulse former at each zero crossing of the signal.

The position pickoff produces a 400-Hz voltage which is proportional to the turbine angle; turbine angle is a function of mass fuel flow. The voltage controls an oscillator which generates a frequency proportional to the voltage input. This frequency drives the fuel-used digital readout and is the input to the fuel flow rate indicator. The oscillator output and the conditioned speed pickoff signal both control logic circuitry to determine the amount



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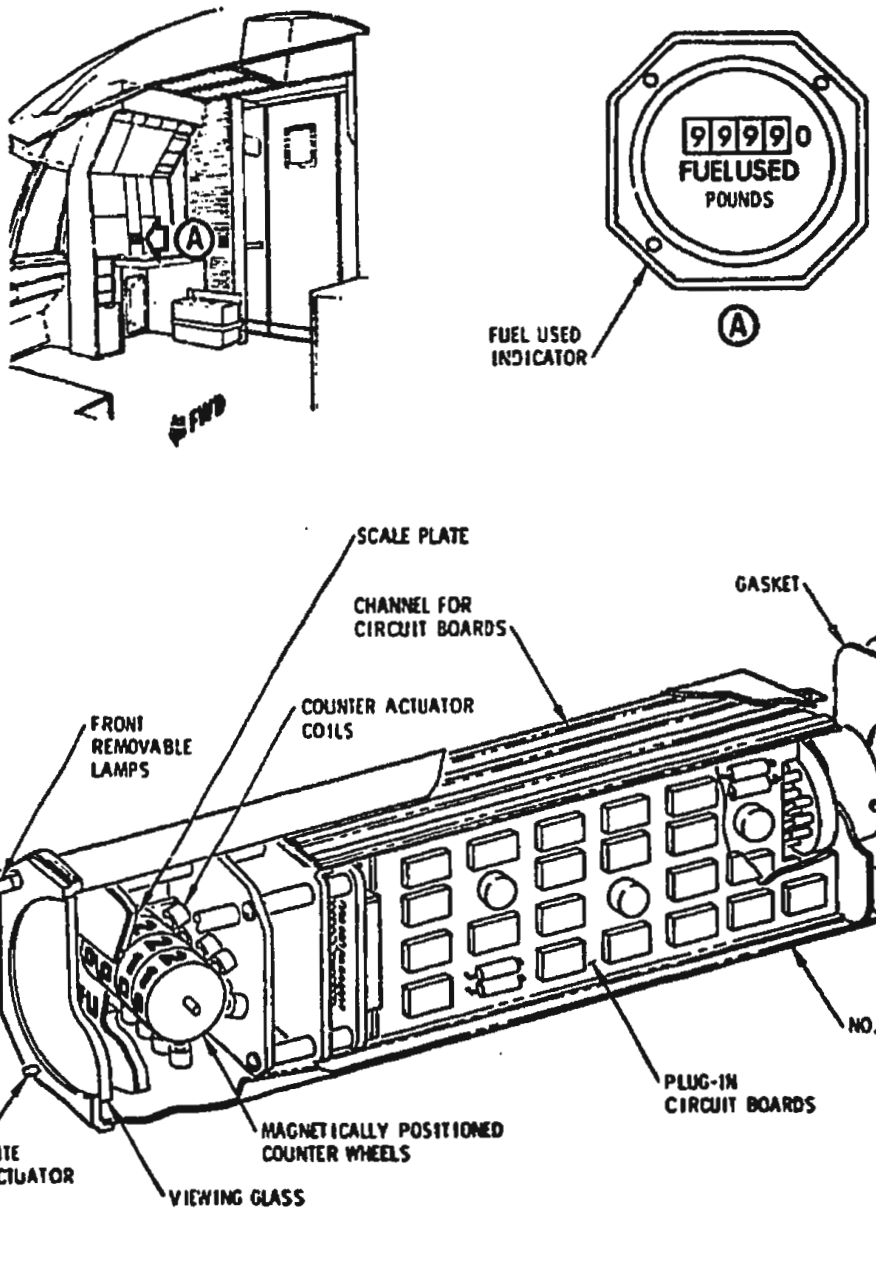
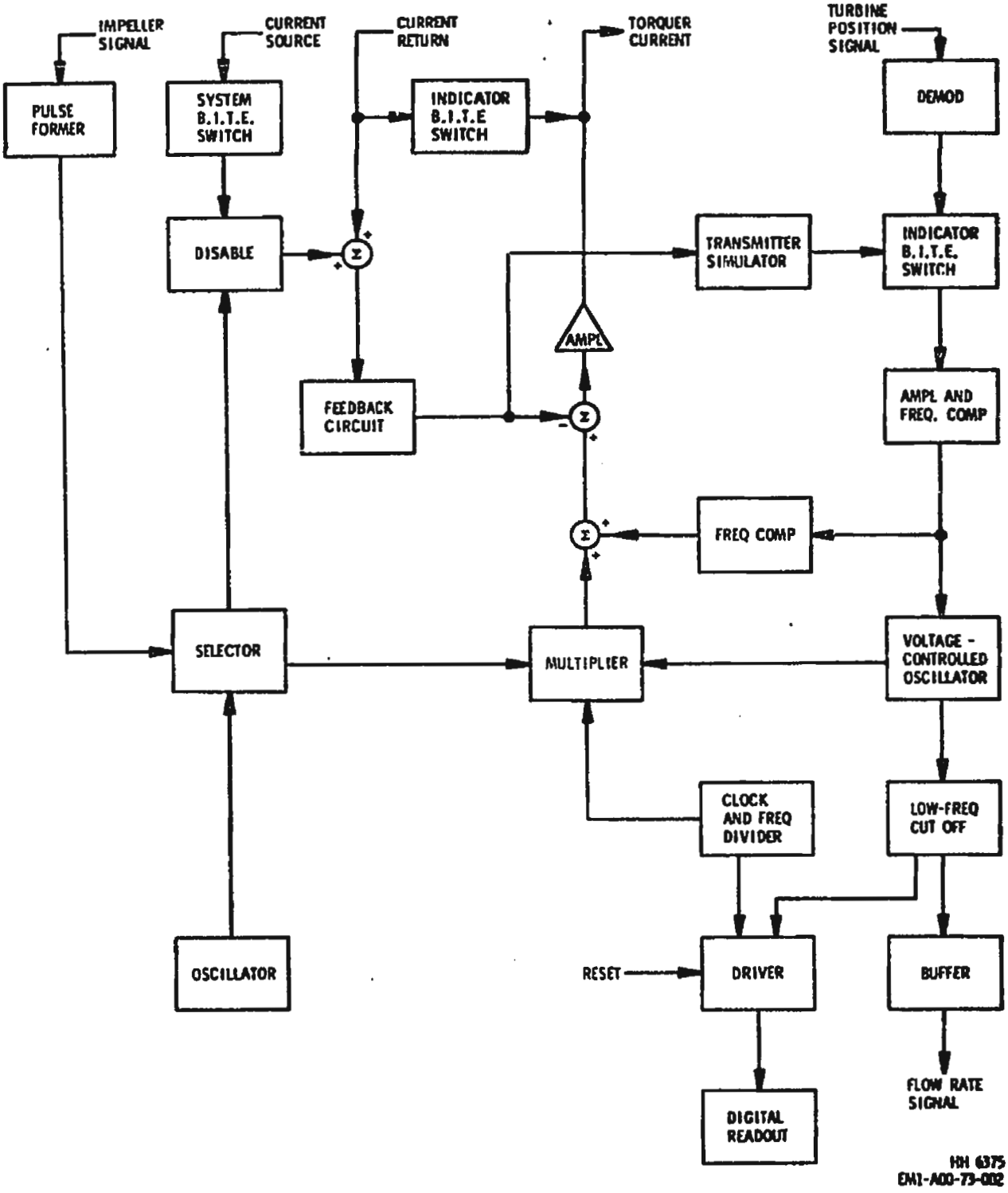
Engine Fuel Flow Rate Indicator Block Diagram
Figure 4



Engine Fuel Used Indicator
Figure 5



Engine Fuel Used Indicator Block Diagram
Figure 6

of current to be fed back to the transmitter torquer to balance the system.

The BITE actuator is a knurled knob that controls a two-position switch. The knob is rotated counterclockwise to test the fuel flow rate and the FUEL USED indicators. The knob is rotated clockwise to test the operation of the entire system.

R FUEL FLOW/FUEL USED SYSTEM - FAULT ISOLATION

R 1. General

R The fault isolation diagrams in this section can be used for
R fault isolation any time a fault is reported or suspected.
R Before fault isolation is started, the PREREQUISITES listed on
R the diagram must be fulfilled. Uncommon abbreviations used on a
R diagram are spelled out on the same diagram.

R If the flight crew reports a trouble using a FIRM Fault Code
R number, the number can be found in the FIRM Fault Code Cross
R Reference Table in the Chapter 73-INDEX.

R The FIRM Fault Code Cross Reference Table includes the flight
R report (fault symptoms) and the exact Section, Figure, Sheet,
R and Block number where fault isolation should begin. (Refer to
R the L-1011 Maintenance Manual Introduction for a more detailed
R explanation on the use of fault isolation diagrams.)

R If a fault is reported or suspected and no FIRM Fault Code is
R available, fault isolation is started at Block 1.

R 2. Fault Isolation/Identification

R Table 101 is a list of Fault isolation data in this section of
R the manual.

R Fault Isolation Data
R Table 106

FIGURE	TITLE
101	Component Location Index
102	Component Locator
103	Fuel Flow Indication Faults
SCHEM 1	Fuel Flow/Fuel Used System Circuits

COMPONENT	QTY	AREA/ACCESS	REFERENCE
FUEL FLOW INDICATOR	1	PILOT CENTER INSTR PNL	73-34-03
FUEL FLOW TRANSMITTER:			73-34-01
WING ENGINES	2	ACCESSORY SECTION, LH HINGED COWL	
NO. 2 ENGINE	1	ACCESSORY SECTION, LH LOWER HINGED COWL	
FUEL USED INDICATOR	3	FE/SO INSTR PNL	73-34-04

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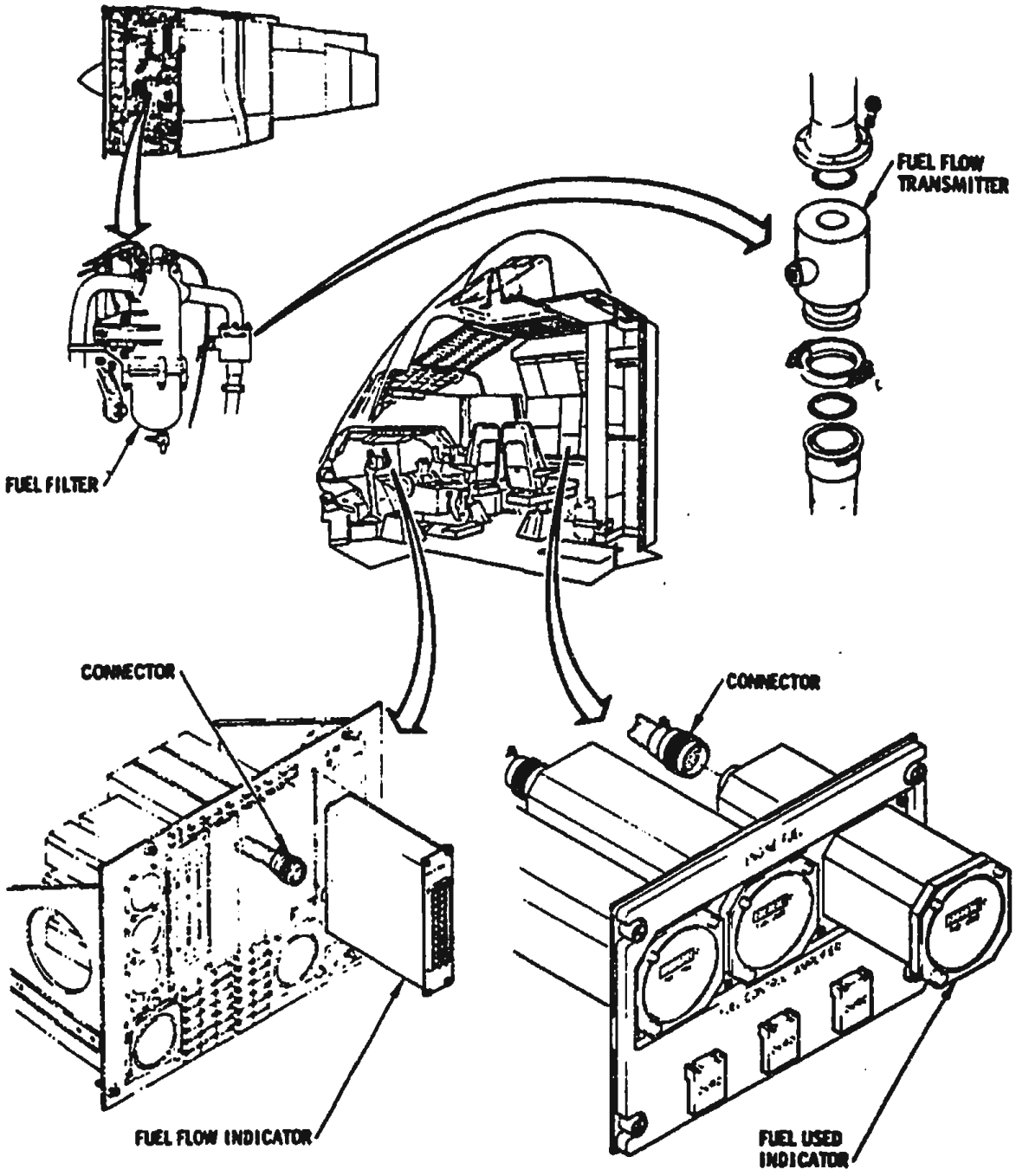
Component Location Index
Figure 101

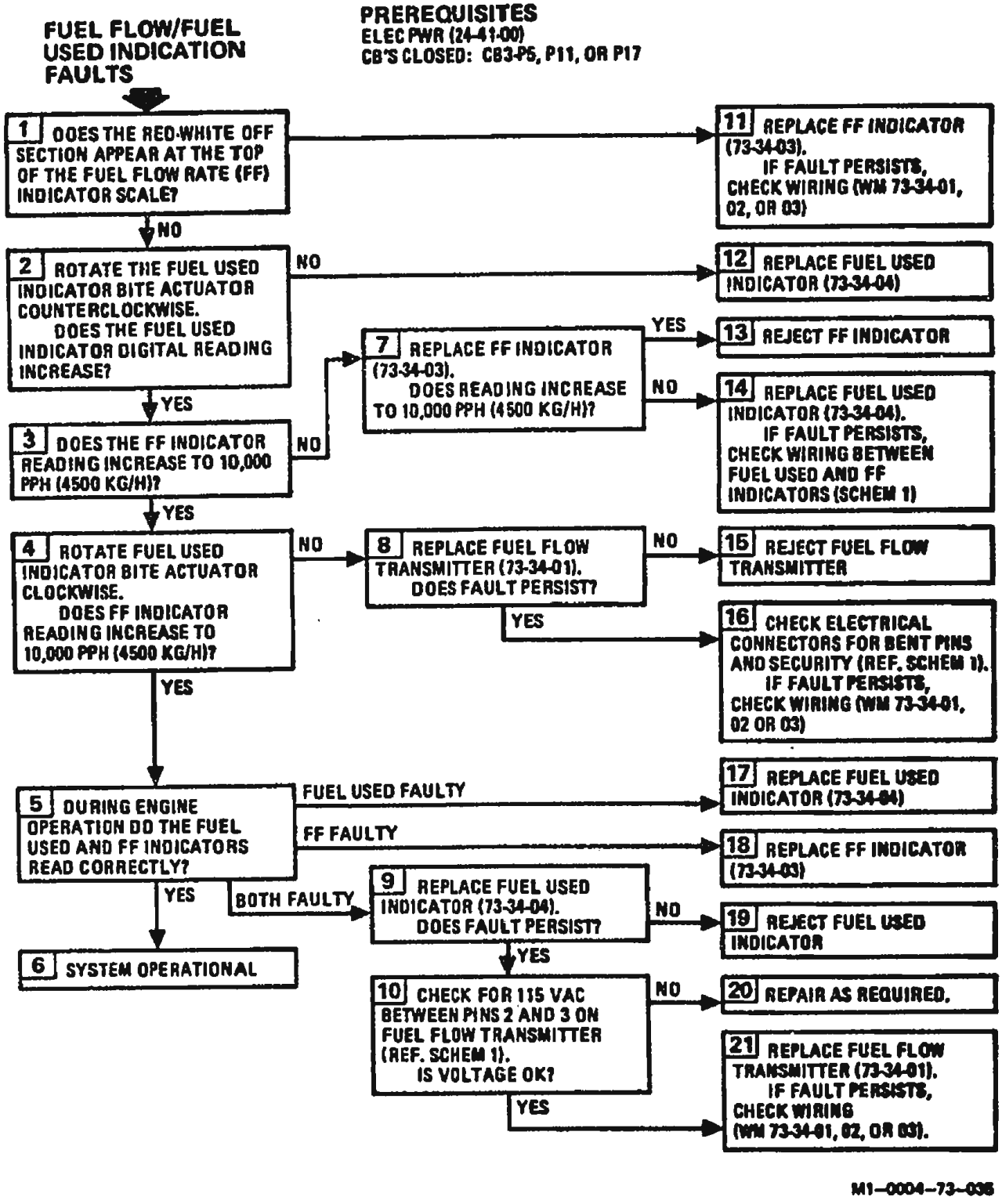
R R

R R 001B EFFECTIVITY: ALL



R R Fuel Flow/Fuel Used System Component Locator
Figure 102

R R 001B EFFECTIVITY: ALL


FUEL FLOW/FUEL USED INDICATION FAULTS
PREREQUISITES
ELEC PWR (24-41-00)
CB'S CLOSED: CB3-P5, P11, OR P17
1 DOES THE RED-WHITE OFF SECTION APPEAR AT THE TOP OF THE FUEL FLOW RATE (FF) INDICATOR SCALE?
NO
11 REPLACE FF INDICATOR (73-34-03). IF FAULT PERSISTS, CHECK WIRING (WM 73-34-01, 02, OR 03)
2 ROTATE THE FUEL USED INDICATOR BITE ACTUATOR COUNTERCLOCKWISE. DOES THE FUEL USED INDICATOR DIGITAL READING INCREASE?
NO
12 REPLACE FUEL USED INDICATOR (73-34-04)
YES
3 DOES THE FF INDICATOR READING INCREASE TO 10,000 PPH (4500 KG/H)?
NO
7 REPLACE FF INDICATOR (73-34-03). DOES READING INCREASE TO 10,000 PPH (4500 KG/H)?
YES
13 REJECT FF INDICATOR
NO
14 REPLACE FUEL USED INDICATOR (73-34-04). IF FAULT PERSISTS, CHECK WIRING BETWEEN FUEL USED AND FF INDICATORS (SCHEM 1)
YES
4 ROTATE FUEL USED INDICATOR BITE ACTUATOR CLOCKWISE. DOES FF INDICATOR READING INCREASE TO 10,000 PPH (4500 KG/H)?
NO
8 REPLACE FUEL FLOW TRANSMITTER (73-34-01). DOES FAULT PERSIST?
NO
15 REJECT FUEL FLOW TRANSMITTER
YES
16 CHECK ELECTRICAL CONNECTORS FOR BENT PINS AND SECURITY (REF. SCHEM 1). IF FAULT PERSISTS, CHECK WIRING (WM 73-34-01, 02 OR 03)
YES
5 DURING ENGINE OPERATION DO THE FUEL USED AND FF INDICATORS READ CORRECTLY?
FUEL USED FAULTY
17 REPLACE FUEL USED INDICATOR (73-34-04)
FF FAULTY
18 REPLACE FF INDICATOR (73-34-03)
YES
BOTH FAULTY
9 REPLACE FUEL USED INDICATOR (73-34-04). DOES FAULT PERSIST?
NO
19 REJECT FUEL USED INDICATOR
YES
6 SYSTEM OPERATIONAL
10 CHECK FOR 115 VAC BETWEEN PINS 2 AND 3 ON FUEL FLOW TRANSMITTER (REF. SCHEM 1). IS VOLTAGE OK?
NO
20 REPAIR AS REQUIRED.
YES
21 REPLACE FUEL FLOW TRANSMITTER (73-34-01). IF FAULT PERSISTS, CHECK WIRING (WM 73-34-01, 02, OR 03).
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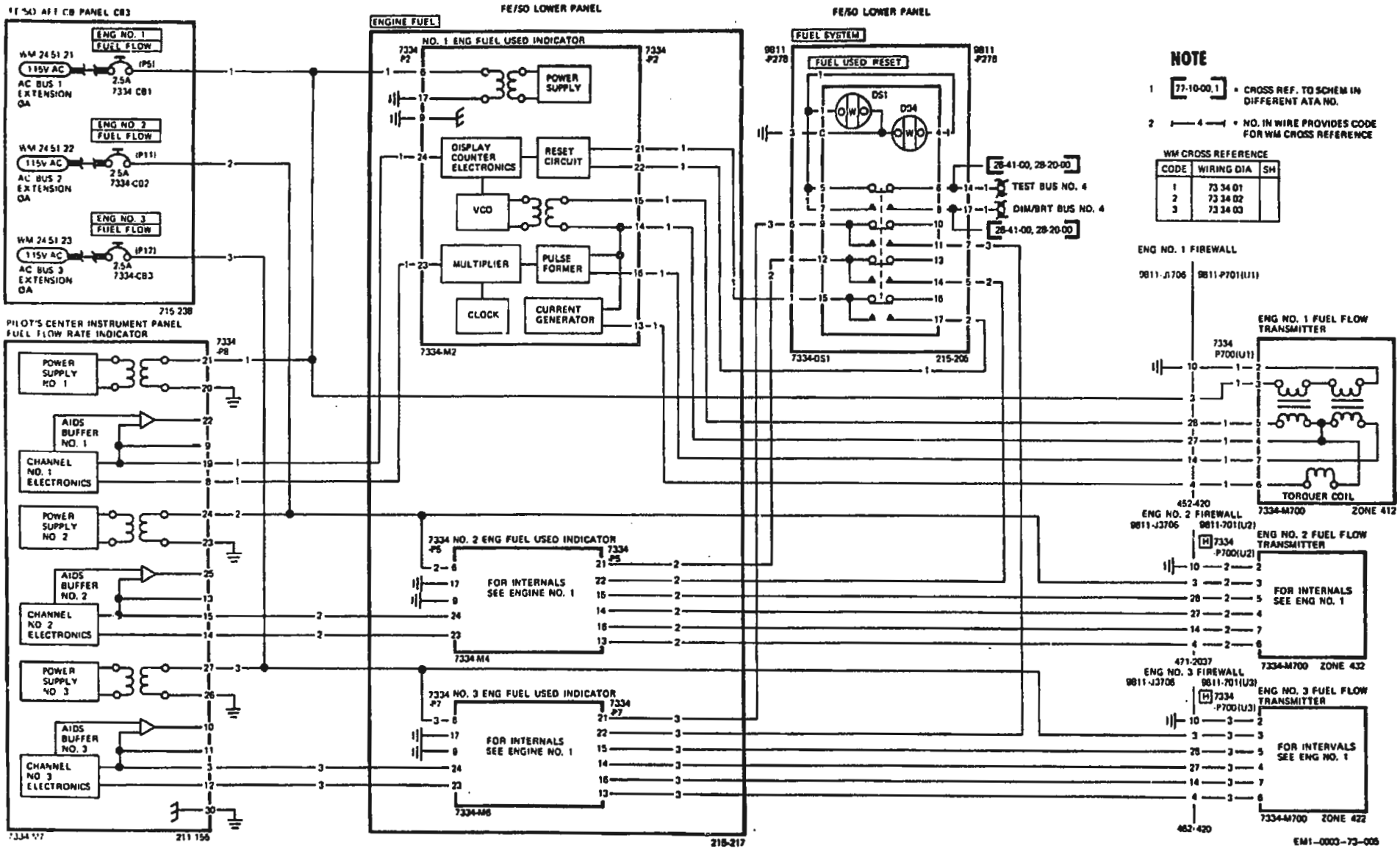
R Fuel Flow/Fuel Used Indicating System Faults
R Figure 103



R Fuel Flow/Fuel Used System Circuits
R SCHEM 1

EFFECTIVITY: ALL

0018

FUEL FLOW/FUEL USED SYSTEM - ADJUSTMENT AND TEST

1. Referenced Procedure

24-41-00 External Power/Ground Service System - Maintenance Practices

2. Adjustment/Test

A. BITE Test

(1) Turn on external power (Ref. 24-41-00).

(2) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, ensure that applicable FUEL FLOW circuit breaker is closed.

(3) On Flight Engineer/Second Officers ENGINE FUEL panel, zone 215, locate applicable FUEL USED indicator and the built-in test equipment (BITE) knob on the lower left corner of the indicator.

(4) Rotate the BITE knob counterclockwise.

(5) Verify that the FUEL USED indicator digital reading increases.

(6) Verify that the applicable fuel flow (FF) rate indicator on the pilots center instrument panel, zone 210, indicates a fuel flow of 10,000 lb per hour ± 1000 lb per hour.

(7) Release the BITE knob and verify that the FF and FUEL USED indicators stop indicating fuel flow and fuel being used.

(8) Rotate the BITE knob clockwise.

(9) Verify that the FF indicator is indicating a fuel flow of approximately 10,000 lb per hour.

(10) Verify that the FUEL USED indicator digital reading increases.

(11) Release the BITE knob and verify that the FF and FUEL USED indicators stop indicating fuel flow and fuel being used.

NOTE: The BITE knob is rotated counterclockwise to test the indicators, and the knob is rotated clockwise to test the entire system.

(12) Turn off external power (Ref. 24-41-00).

FUEL FLOW TRANSMITTER - REMOVAL AND INSTALLATION

1. Equipment and Materials

Container (minimum capacity: 5 U.S. gallons, 4 Imperial gallons, or 18 liters)

Flexible hose: approximate length of 72 in. (1800 mm) and ID of 0.5 in. (12 mm)

Dry film lubricant, British Spec D.T.D. 5530 (Molykote type G), or equivalent

Protective caps and plugs

2. Referenced Procedures

24-41-00	Electrical Power/Ground Service System - Maintenance Practices
70-02-01	Lubrication and Fitting of Rubber Sealing Rings - Maintenance Practices
70-12-02	Fitting V-band Coupling Clamps - Maintenance Practices
71-11-00	Engines No. 1 and No. 3 Cowling - Servicing
71-12-01	LH and RH Lower Hinged Cowls - Servicing
71-12-05	LH and RH Upper Hinged Cowls - Servicing
73-00-00	Engine Fuel and Control - Servicing
73-00-00	Engine Fuel and Control - Adjustment and Test
73-11-02	Fuel Low-pressure Filter - Maintenance Practices
73-11-09	Fuel Tubes - Maintenance Practices
73-34-00	Fuel Flow/Fuel Used System - Adjustment and Test

CR SUBJECT: Fluctuating Fuel Flow & Troubleshooting For Same.

CR Twa is experiencing an unusually large number of log
CR write-ups regarding fluctuating fuel flow. In some
CR instances other parameters fluctuate with the fuel flow
CR indication. The usual approach is to change the fuel flow

CR regulator (FFR); however, this may not always provide the
CR desired effect.

CR Fuel flow fluctuations with excursions up to 200 PPH have
CR been observed and are considered normal fuel flow indication
CR problems. Most generally the fluctuation is generated
CR within the fuel flow transmitter.

CR In an effort to reduce unnecessary fuel flow fluctuating log
CR write-ups, fluctuations up to 200 PPH will be considered
CR acceptable and require no further maintenance action.
CR However, should other parameters follow the fuel flow
CR fluctuation, it will be necessary to replace the fuel flow
CR regulator.

CR Trouble shooting the indication system first will pay
CR dividends in lowering FFR removals that are very expensive.

CR Please keep MCI Power Plant Engineering (MCIEE) advised of
CR all instances of fluctuation so appropriate action may be
CR taken.

3. Removal/Installation

CR NOTE: Fuel flow fluctuations of up to 200 PPH will be
CR considered acceptable and require no further maintenance
CR action. Should other parameters follow the fuel flow
CR fluctuation it will be necessary to replace the fuel flow
CR regulator. Advise MCIEE of all instances of fluctuation
CR so appropriate action may be taken.

Service Bulletins referred to:

SB73-3215 - Modified GE Flowmeter Support Bracket

SB73-3669 - LP Fuel Tube Connector with Bracket End Float

SB73-5220 LP Fuel Tube Connectors with Hard Coating deleted

A. Removal

(1) Close applicable engine fuel firewall shutoff valve as follows:

(a) Turn on electrical power (Ref. 24-41-00).

(b) On pilots overhead panel pull and tag applicable FIRE PULL handle.

(c) Turn off electrical power.

(2) On Flight Engineer/Second Officers aft circuit breaker panel, zone 215, open and tag applicable circuit breaker FUEL FLOW (P5, P11, or P17).

(3) Open applicable LH hinged cowl 413A or 423A for engine No. 1 or 3 (Ref. 71-11-00), or 433AL and 433DL for engine No. 2 (Ref. 71-12-01 and 71-12-05).

(4) Drain low-pressure filter (Ref. 73-11-02).

(5) Disconnect fuel flow transmitter electrical connector (1) (Ref. Fig. 401).

(6) Disconnect connector (2) from connector (5) and connector (3) from transmitter (Ref. 70-12-02), and remove tube.

(7) Support transmitter then disconnect connector (4) and remove transmitter.

(8) Install caps or plugs on all exposed openings and electrical connector.

B. Installation

NOTE: Refer to 73-11-09 for correct procedures for fitting fuel tubes.

(1) Verify that FIRE PULL handle pulled in Step 3A(1) is pulled and tagged.

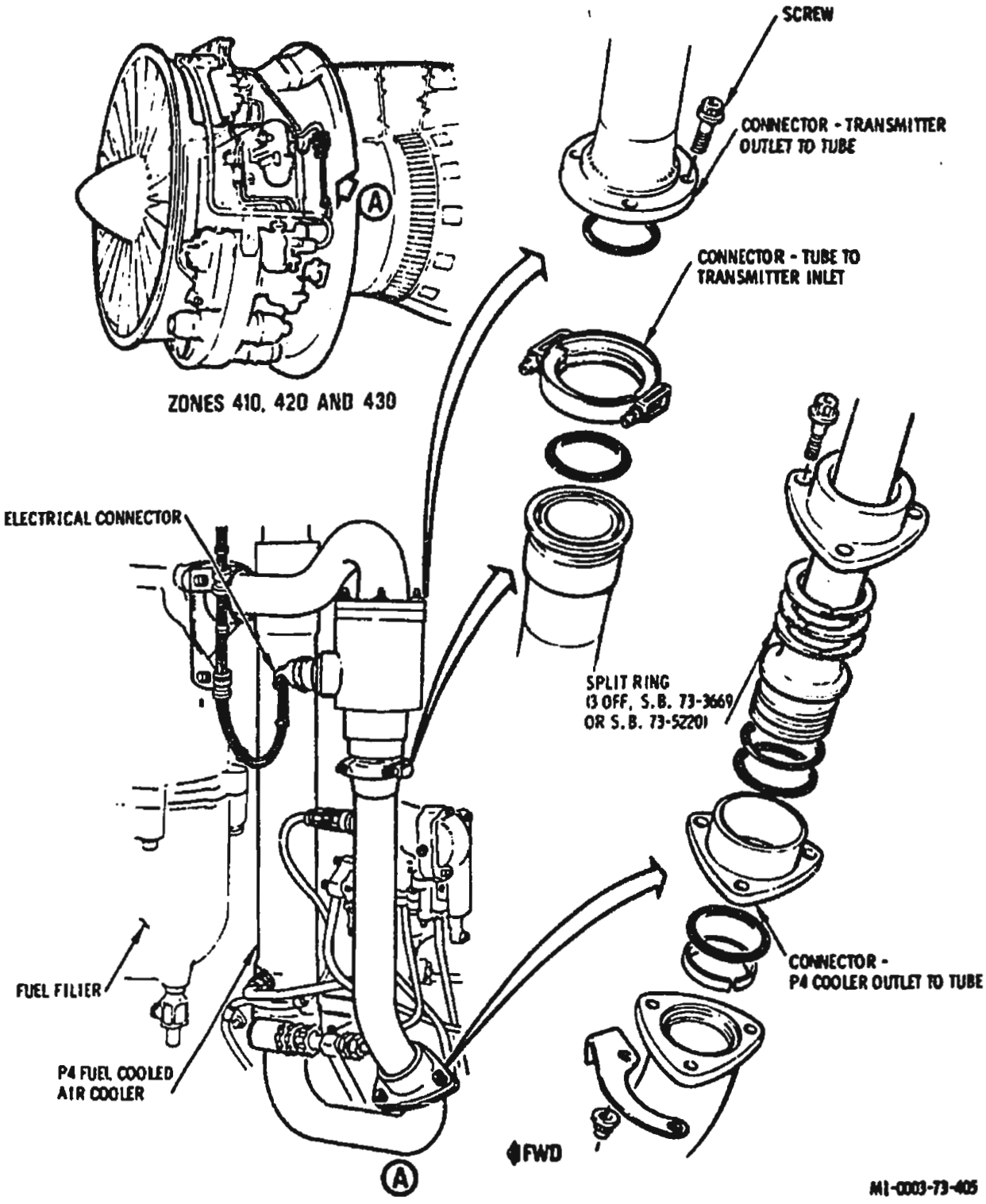
(2) Verify that circuit breaker opened in Step 3A(2) is open and tagged.

(3) Remove caps or plugs (Ref. Fig. 401) from electrical connector and all openings.

(4) Lubricate and install (Ref. 70-02-01) a new seal ring to connector (4).

(5) Apply dry film lubricant to threads of securing bolts (4 off), position transmitter and support bracket, and secure to connector (4).

NOTE: On engines not incorporating SB73-3215, the support bracket is interposed between the transmitter and two inboard bolts. On engines incorporating SB73-3215, the support bracket is interposed between the transmitter and one inboard bolt.



Fuel Flow Transmitter - Removal and Installation
Figure 401

(6) Lubricate and install (Ref. 70-02-01) a new seal ring on P4 cooler fuel outlet connector (5).

(7) Lubricate and install (Ref. 70-02-01) a new seal ring on connectors (2) and (3).

(8) Install tube and secure connectors (2) and (5) positioning bracket under nuts.

(9) Secure connector (3) using double T-bolt V-band coupling (Ref. 70-12-02).

(10) Connect and secure electrical connector.

(11) Remove tag and close circuit breaker opened in Step 3A(2), then close applicable engine fuel firewall shutoff valve as follows:

(a) Turn on electrical power (Ref. 24-41-00).

(b) Remove tag and push in applicable FIRE PULL handle.

(c) Turn off electrical power.

(12) Prime engine LP fuel system (Ref. 73-00-00, Servicing).

(13) Test fuel flow/fuel used indicating system (Ref. 73-34-00).

(14) Test for leaks at points disturbed (Ref. 73-00-00, Adjustment and Test).

(15) Close LH hinged cowl.

FUEL FLOW RATE INDICATOR - REMOVAL AND INSTALLATION

1. Equipment and Materials

   Protective caps

2. Referenced Procedure

   73-34-00 Fuel Flow/Fuel Used System - Adjustment and Test

3. Removal/Installation

   A. Removal

      (1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag applicable FUEL FLOW circuit breaker.

      On Flight Engineer/Second Officers overhead circuit breaker panel CB2, zone 215, open and tag circuit breaker CTR INSTR & GLARE SHLD.

      (2) Locate fuel flow rate indicator (Ref. Fig. 401) on pilots center instrument panel, zone 210.

      (3) Loosen triwing fasteners and withdraw indicator to gain access to electrical connector.

      (4) Disconnect electrical receptacle connector from indicator. Cap and stow connector.

   B. Installation

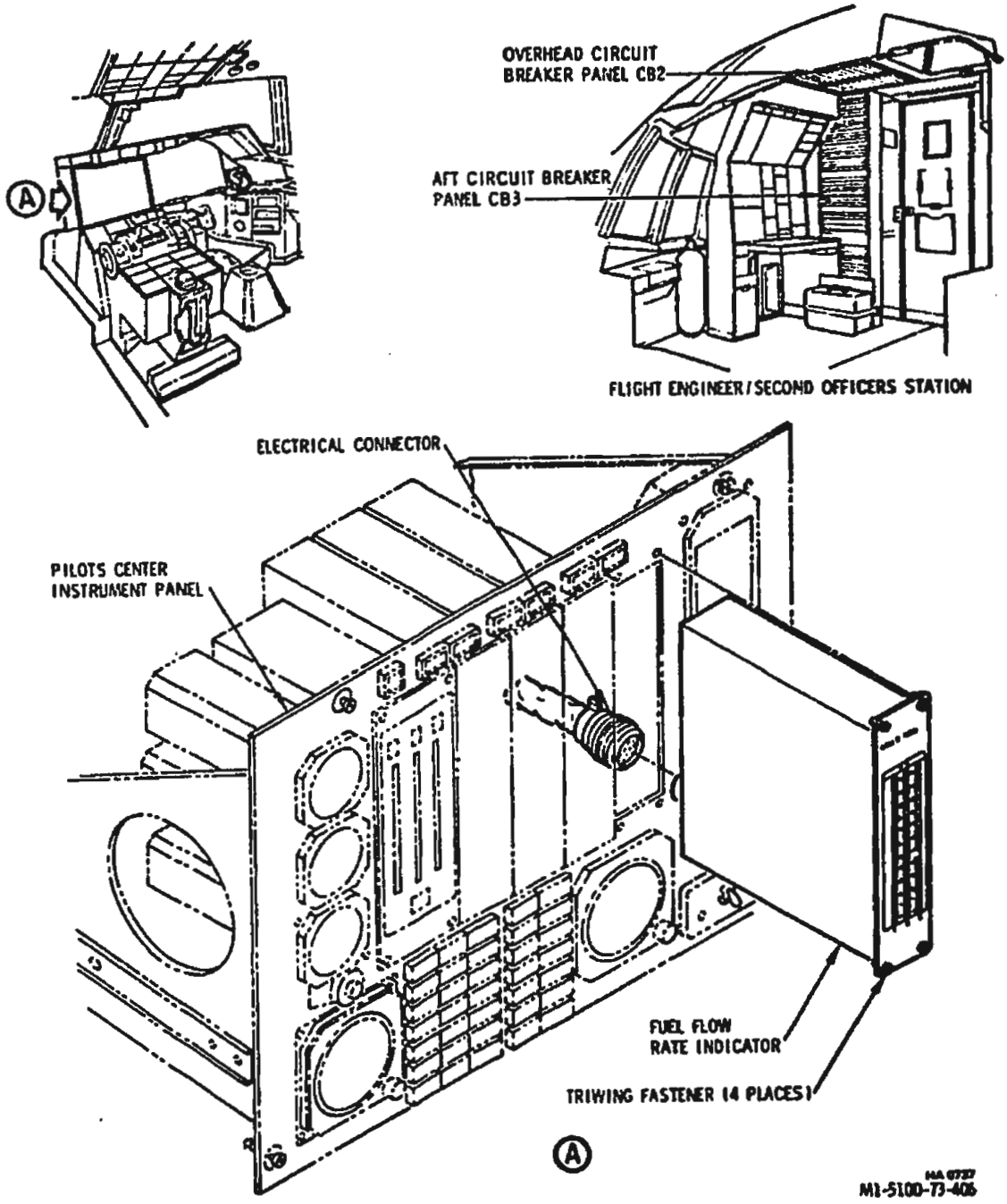
      (1) Verify that circuit breakers opened in Step 3A(1) are open and tagged.

      (2) Remove caps and mate connector on indicator to harness connector.

      (3) Slide indicator into panel cutout until flange contacts panel. Secure indicator by tightening triwing fasteners.

      (4) Remove tags and close circuit breakers opened in Step 3A(1).

      (5) Perform system test (Ref. 73-34-00).



Fuel Flow Rate Indicator - Removal and Installation
Figure 401

FUEL USED INDICATOR - REMOVAL AND INSTALLATION

1. Equipment and Materials

   Protective caps

2. Referenced Procedure

   73-34-00 Fuel Flow/Fuel Used System - Adjustment and Test

3. Removal/Installation

   A. Removal

      (1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag applicable circuit breaker FUEL FLOW.

      On Flight Engineer/Second Officers overhead circuit breaker panel CB2, zone 215, open and tag circuit breaker F/E INSTR.

      (2) On Flight Engineer/Second Officers panel, zone 210, locate applicable FUEL USED indicator (Ref. Fig. 401).

      (3) Loosen clamp screws that secure the indicator in the panel.

      (4) Withdraw indicator and disconnect the electrical connector. Cap and stow connector.

   B. Installation

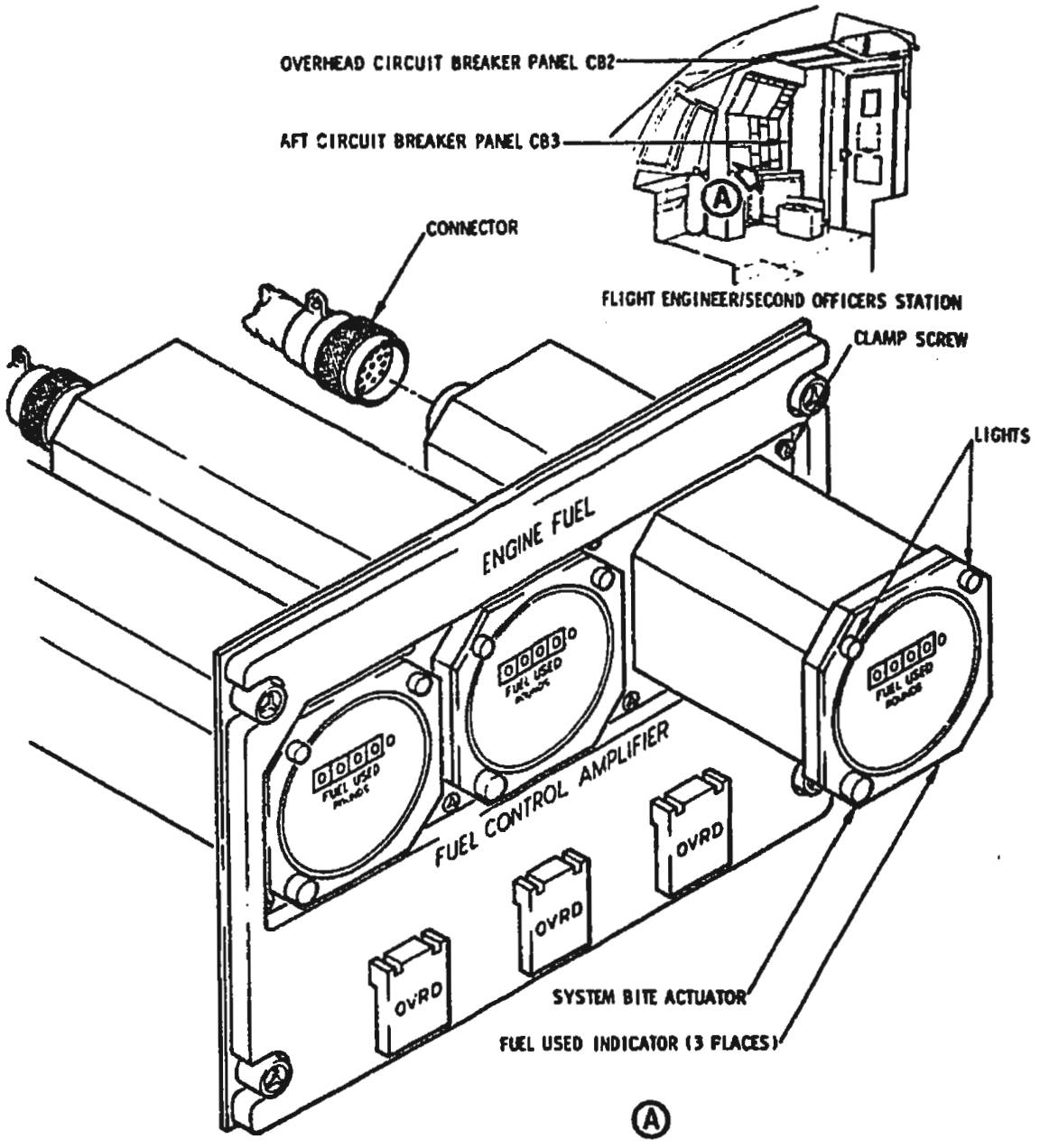
      (1) Verify that circuit breakers opened in Step 3A(1) are open and tagged.

      (2) Mate electrical connector on indicator-to-harness connector.

      (3) Slide indicator into panel cutout until bezel is positioned against panel.

      (4) Secure indicator by tightening clamp screws. Torque clamp screws 5 to 8 lb in.

      (5) Remove tags and close circuit breakers opened in Step 3A(1).



M1-0100-73-407

R Fuel Used Indicator - Removal and Installation
R Figure 401

EFFECTIVITY: ALL

001B

(6) Perform system test (Ref. 73-34-00).

FUEL TEMPERATURE SYSTEM - DESCRIPTION AND OPERATION

1. General

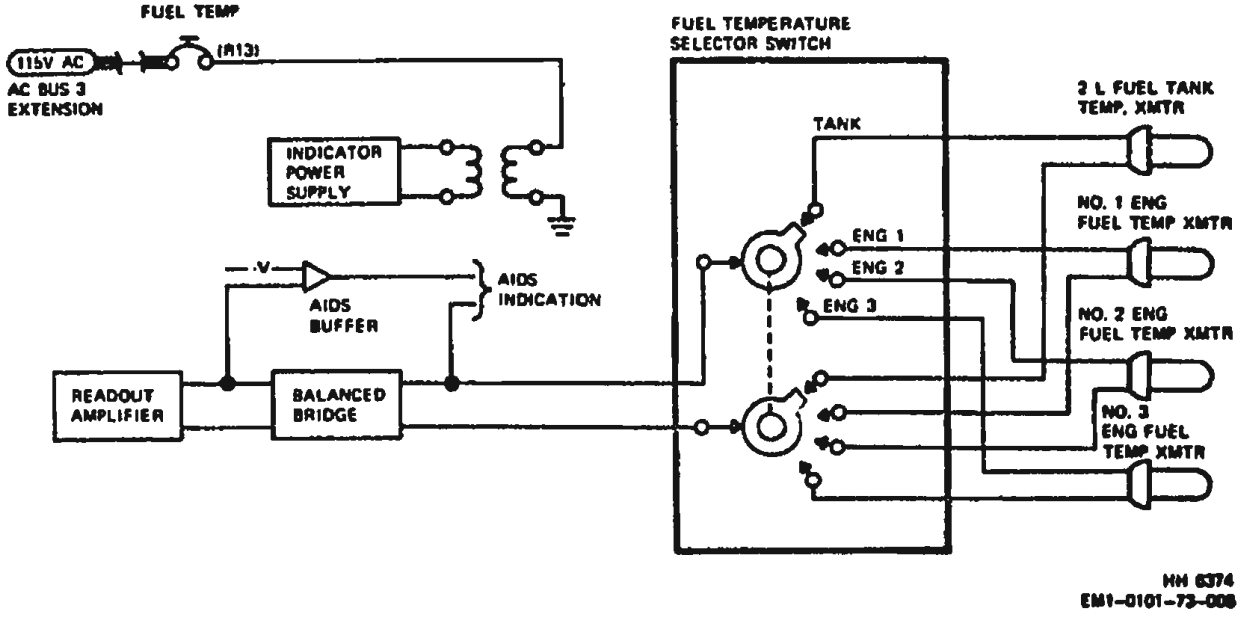
The engine fuel temperature indicating system provides fuel temperature data to the Flight Engineer/Second Officer. Fuel temperature is sensed by resistance temperature detectors at each engine, zones 412, 422, and 432, and at fuel tank 2L, zone 532.

The desired temperature source is selected by the fuel temperature selector rotary switch. The engine fuel temperature indicator (Ref. Fig. 1) displays the temperature from one detector at a time. The rotary switch and indicator are located on the Flight Engineer/Second Officers FUEL SYSTEM panel, zone 215.

2. Fuel Temperature Bulb

A. Description and Operation

The fuel temperature bulb (Ref. Fig. 2), zone 412, 422, and 432, consists of a closed tube housing a spiral of nickel



Fuel Temperature Simplified Schematic
Figure 1

wire, of known electrical resistance, that is connected to an electrical receptacle on the bulb. The bulb is positioned in the low pressure fuel filter housing so that fuel flows around the tube.

Variations in the fuel temperature cause variations in resistance of the wire proportional to the temperature change. As the wire forms one arm of a balanced bridge in the indicator circuit, the change in resistance disturbs the balance and causes the indicator pointer to deflect and so indicate the fuel temperature.

3. Engine Fuel Temperature Indicator

A. Description

A fuel temperature indicator is located on the Flight Engineer/Second Officers FUEL SYSTEM panel, zone 215. This indicator provides an analog (pointer) display of fuel temperature.

The indicator (Ref. Fig. 3) is enclosed in a standard No. 2 ATI case. The scale plate (dial) is graduated to indicate temperatures from -50 to +150 degrees C. A built-in-test-equipment (BITE) actuator is located in the lower left front corner of the indicator. Front-mounted, quickly replaceable lamps and a wedge-type viewing glass are used to illuminate the dial.

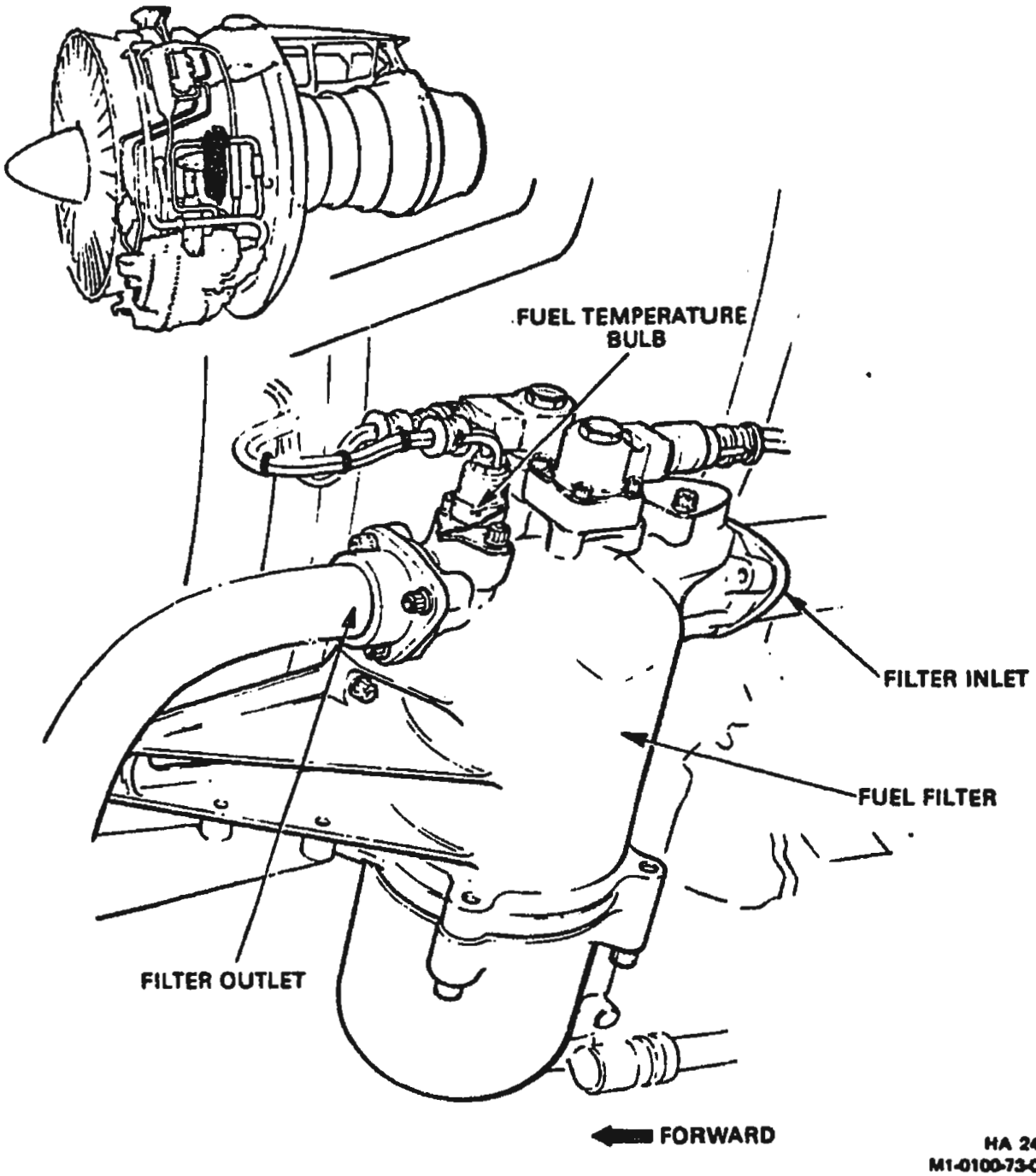
Electronics to condition the input signal and to drive the pointer display are located in the rear of the indicator case. The pointer is positioned by a dc torquer in the front of the case. The torquer contains a followup potentiometer with the brush directly connected to the pointer shaft.

B. Operation

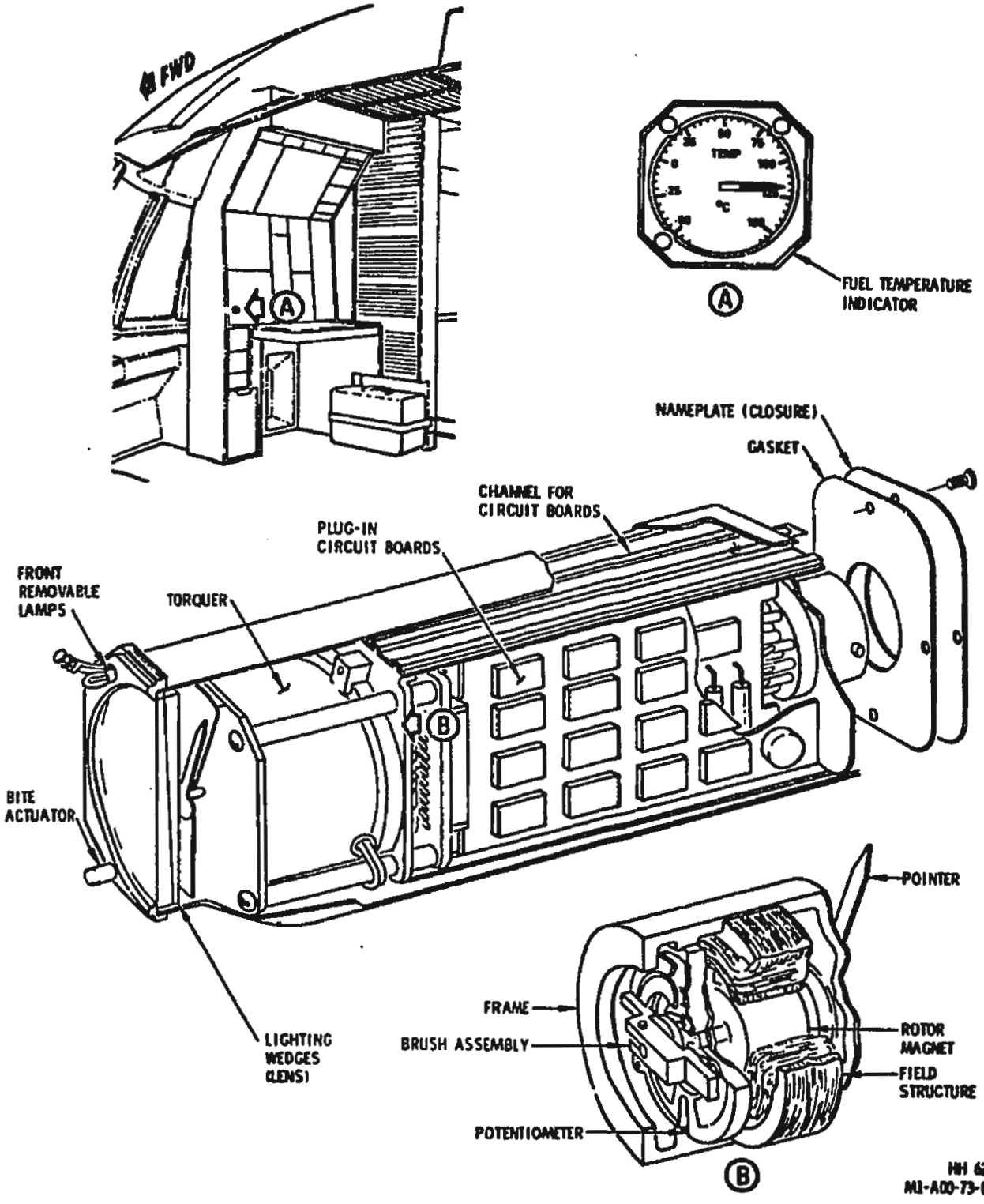
The indicator requires 115V, 400-Hz operating power. The indicator lighting operates on 5V, 400-Hz power.

The indicator input circuit consists of three legs of a resistance bridge circuit. One of the three legs is the followup potentiometer. The fourth leg of the bridge is the resistance temperature detector (RTD) which is submerged in fuel. A change in fuel temperature causes a change in RTD resistance which unbalances the bridge circuit and provides a voltage output that is a function of fuel temperature.

The bridge output voltage is compared to the output of the followup potentiometer (Ref. Fig. 4). The differential



Fuel Temperature Bulb
Figure 2



Engine Fuel Temperature Indicator
Figure 3

voltage is amplified to provide the driving signal for the torquer. Rotation of the torquer and potentiometer brush is in a direction that makes the potentiometer output voltage equal the bridge output. When the voltages are equal, torque loading is zero. The torquer and attached pointer come to rest at a position which represents the fuel temperature.

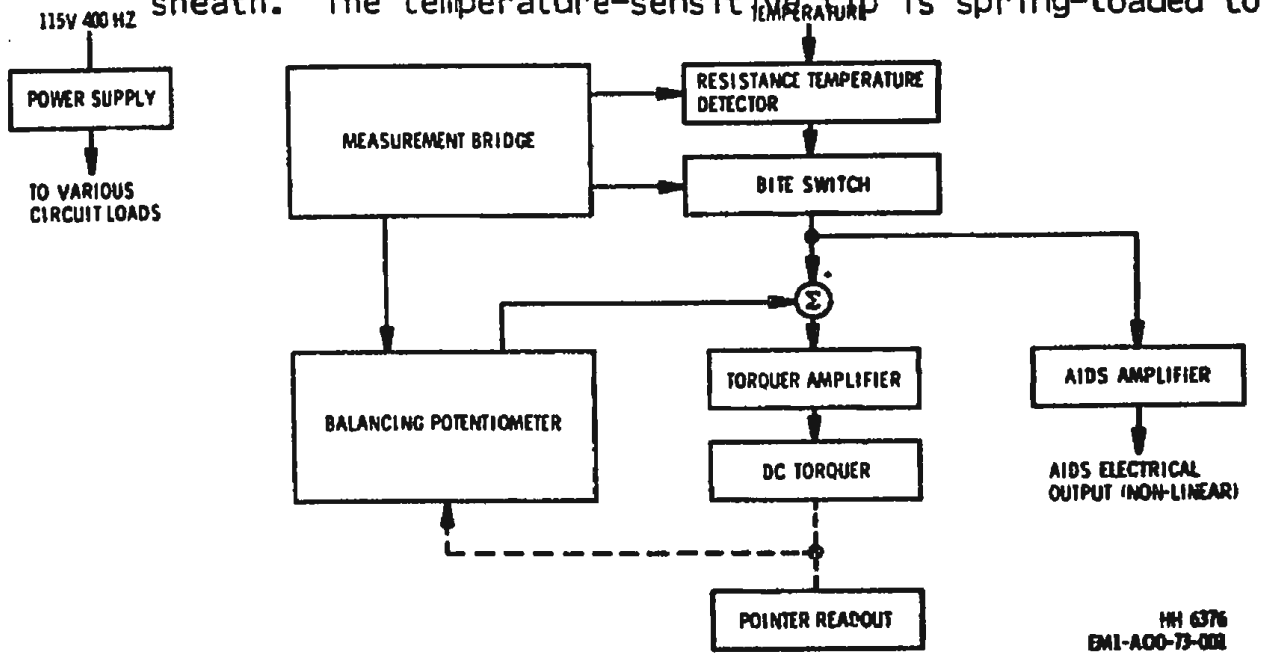
When the BITE switch is actuated, a predetermined signal replaces the sensor signal. The predetermined signal causes the pointer to indicate approximately +50 degrees C on the indicator scale.

4. Wing Tank Fuel Temperature Sensor

A. Description and Operation

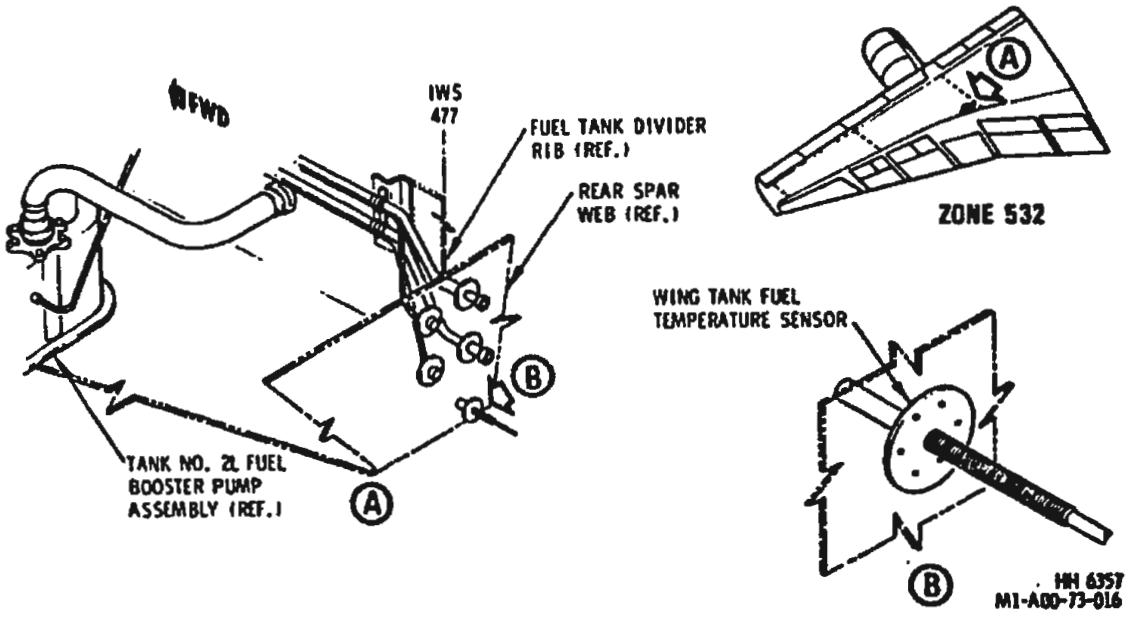
The wing tank fuel temperature sensor is a resistance temperature detector that provides a temperature-dependent signal to the engine fuel temperature indicator.

The sensor is enclosed in a flanged sheath (Ref. Fig. 5) that is riveted to the No. 2L fuel tank wall, zone 532. A bayonet coupling allows the sensor to be removed from the sheath. The temperature-sensitive tip is spring-loaded to



Engine Fuel Temperature Indicator Block Diagram
Figure 4

provide good thermal contact with the bottom of the sheath. There are three wires integrated with the assembly. One wire is a case ground, while the other two allow the sensor to be inserted as one leg of the measurement bridge circuit in the engine fuel temperature indicator.



Wing Tank Fuel Temperature Sensor
Figure 5

R # FUEL TEMPERATURE SYSTEM - FAULT ISOLATION

R 1. General

R The fault isolation diagrams in this section can be used for fault isolation any time a fault is reported or suspected. Before fault isolation is started, the PREREQUISITES listed on the diagram must be fulfilled.

R If the flight crew reports a trouble using a FIRM Fault Code number, the number can be found in the FIRM Fault Code Cross Reference Table in the Chapter 73 INDEX.

R The FIRM Fault Code Cross Reference Table includes the flight report (fault symptoms) and the exact Section, Figure, Sheet, and Block number where fault isolation should begin. (Refer to the L-1011 Maintenance Manual Introduction for a more detailed explanation on the use of fault isolation diagrams.)

R If a fault is reported or suspected and no FIRM Fault Code is available, the function or fault indication can be found in the table below. When a diagram is selected in this manner fault isolation is started at Block 1.

R 2. Fault Isolation/Identification

R Table 101 is a list of fault isolation data in this section of the manual.

R Fault Isolation Data
Table 101

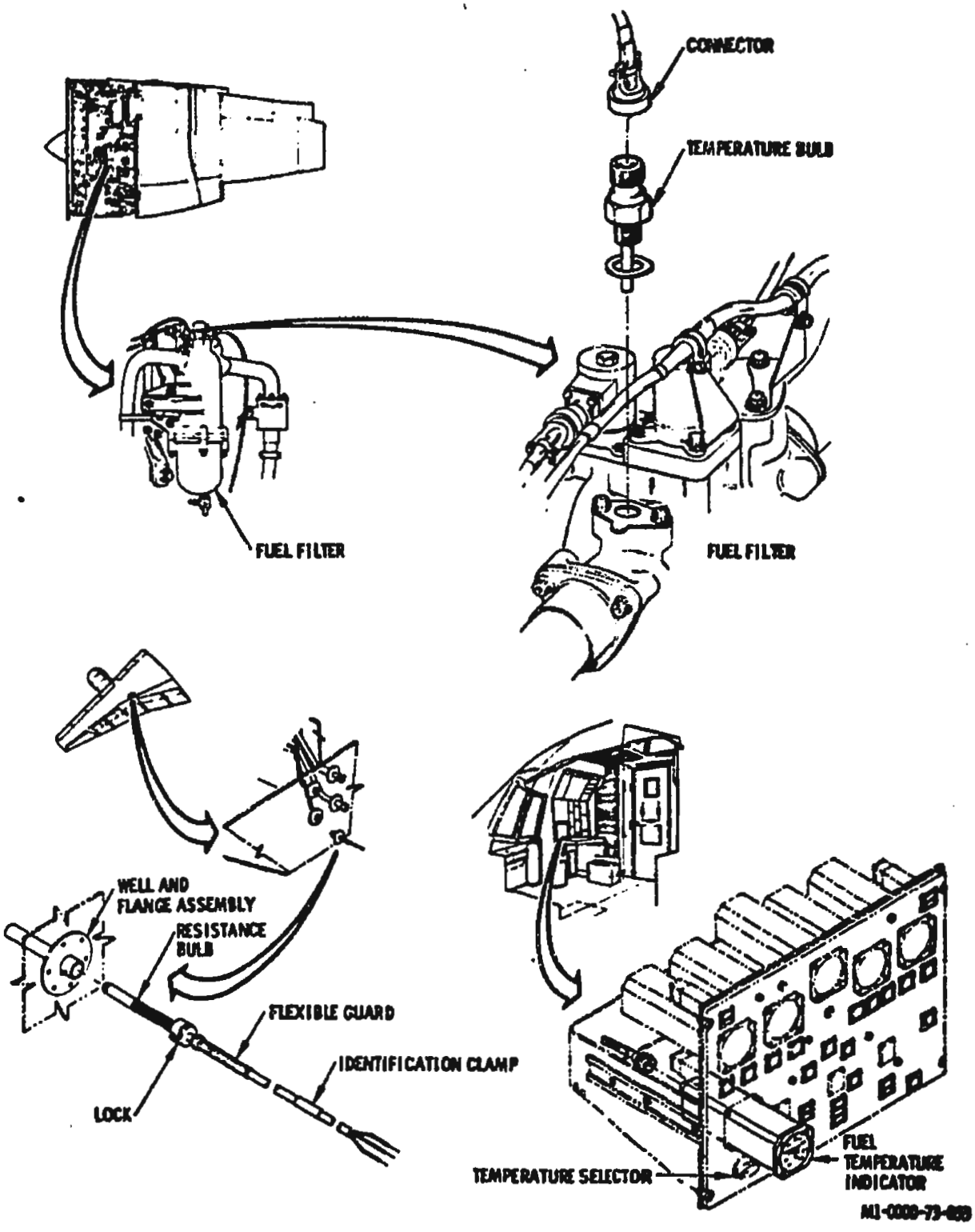
FIGURE	TITLE
101	Component Locator Index
102	Components Locator
103	Fuel Temperature Abnormal Indication
SCHEM 1	Fuel Temperature System Electrical Circuits

COMPONENT	QTY	AREA/ACCESS	REFERENCE
FUEL TEMPERATURE BULB:			
WING ENGINES	2	ACCESSORIES SECTION/LH HINGED COWL	
NO. 2 ENGINE	1	ACCESSORIES SECTION/ UPPER LH HINGED COWL	73-34-01
FUEL TEMPERATURE INDICATOR	1	FLT STA/FUEL SYSTEM PNL	73-34-02
WING TANK FUEL TEMPERATURE SENSOR	1	LEFT WING BOTTOM/541GB	73937-04

M1-0000-73-082

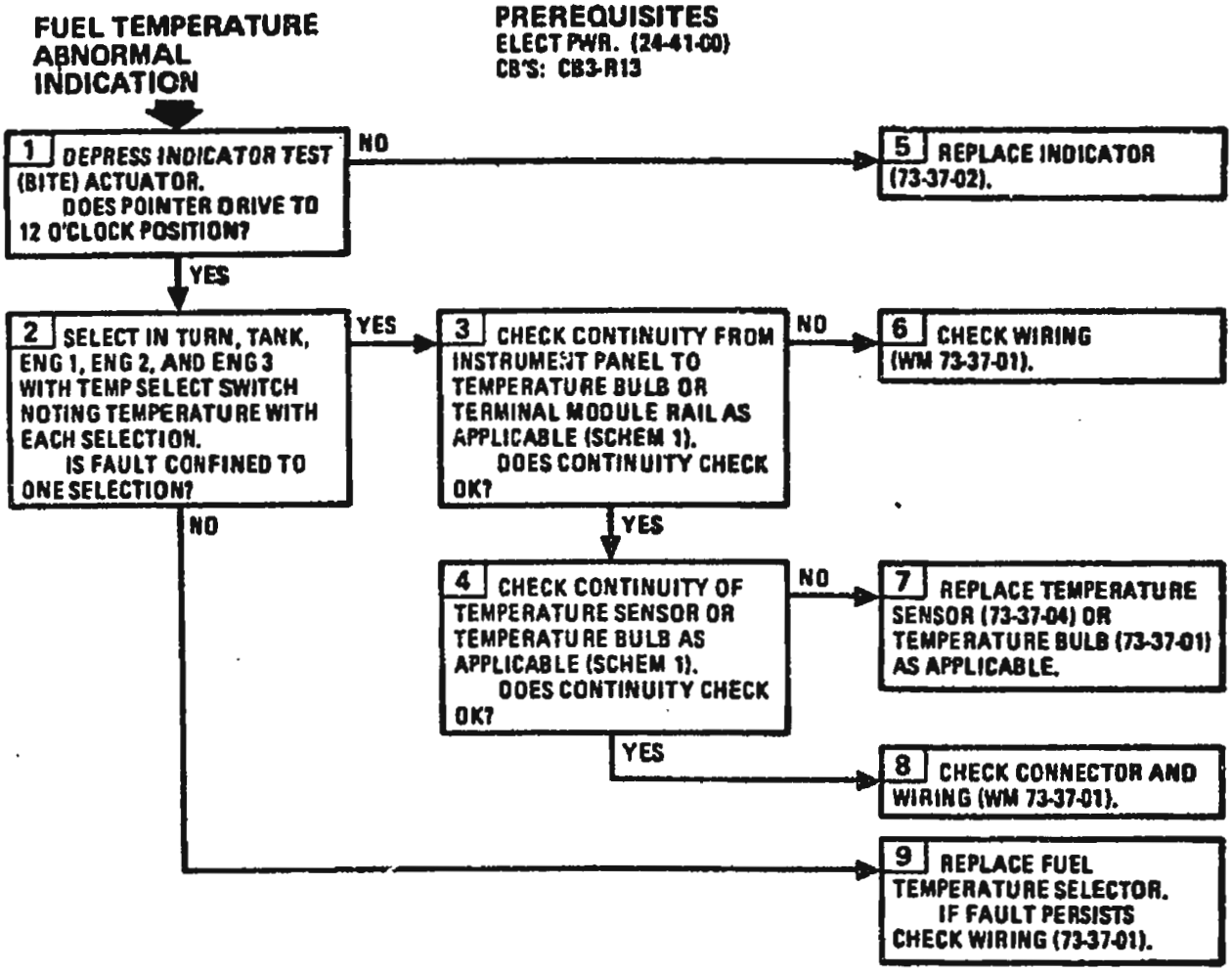
R
R

Component Locator Index
Figure 101



R R Component Locator
Figure 102

R R 001B EFFECTIVITY: ALL

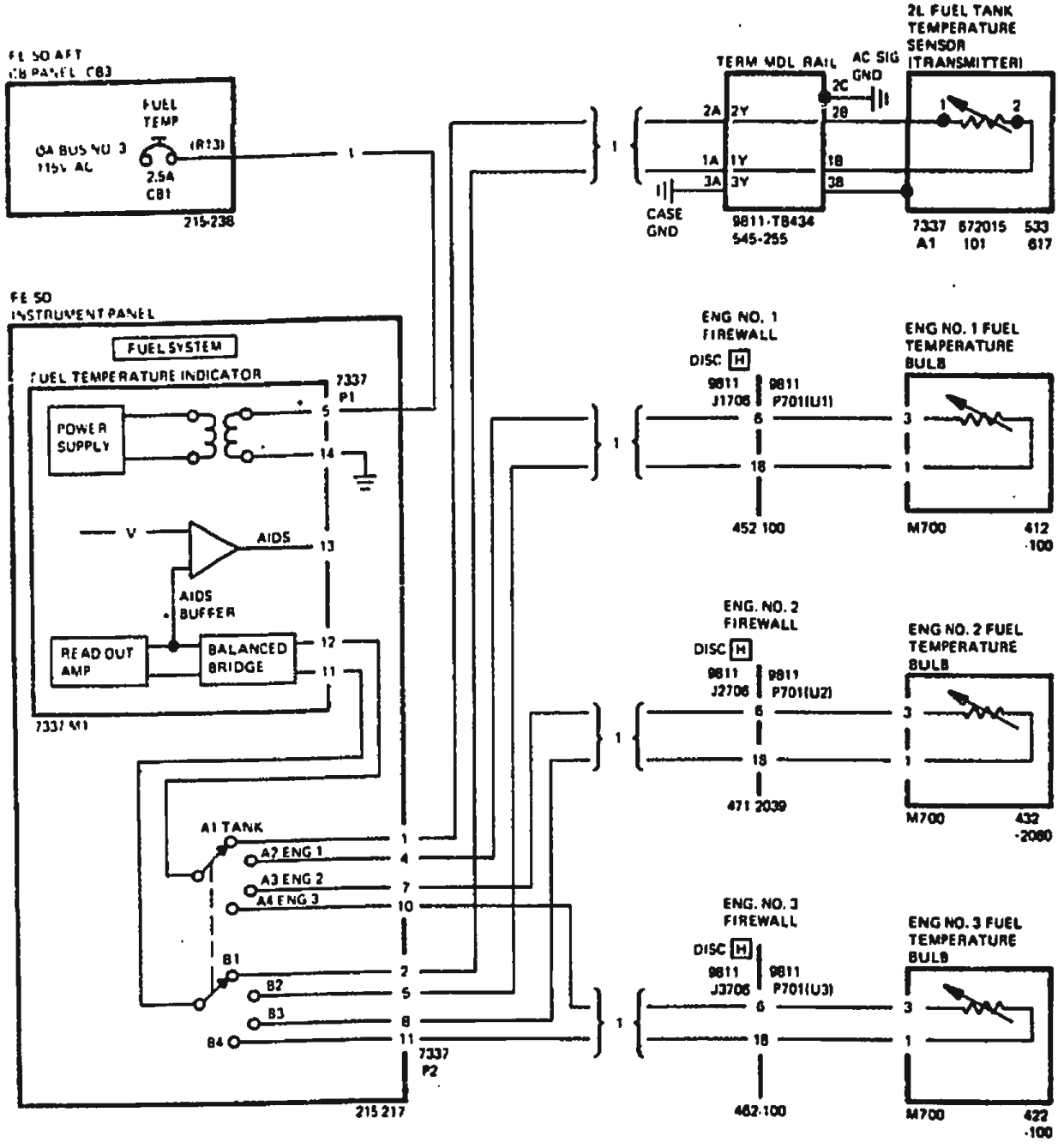

FUEL TEMPERATURE ABNORMAL INDICATION
PREREQUISITES
ELECT PWR. (24-41-00)
CB'S: CB3-R13
1 DEPRESS INDICATOR TEST (BITE) ACTUATOR. DOES POINTER DRIVE TO 12 O'CLOCK POSITION?
NO
5 REPLACE INDICATOR (73-37-02).
YES
2 SELECT IN TURN, TANK, ENG 1, ENG 2, AND ENG 3 WITH TEMP SELECT SWITCH NOTING TEMPERATURE WITH EACH SELECTION. IS FAULT CONFINED TO ONE SELECTION?
YES
3 CHECK CONTINUITY FROM INSTRUMENT PANEL TO TEMPERATURE BULB OR TERMINAL MODULE RAIL AS APPLICABLE (SCHEM 1). DOES CONTINUITY CHECK OK?
NO
6 CHECK WIRING (WM 73-37-01).
YES
4 CHECK CONTINUITY OF TEMPERATURE SENSOR OR TEMPERATURE BULB AS APPLICABLE (SCHEM 1). DOES CONTINUITY CHECK OK?
NO
7 REPLACE TEMPERATURE SENSOR (73-37-04) OR TEMPERATURE BULB (73-37-01) AS APPLICABLE.
YES
8 CHECK CONNECTOR AND WIRING (WM 73-37-01).
NO
9 REPLACE FUEL TEMPERATURE SELECTOR. IF FAULT PERSISTS CHECK WIRING (73-37-01).

M1-0002-73-108

Fuel Temperature Abnormal
Figure 103

EFFECTIVITY: ALL

001B



NOTE

} 1 { NO IN WIRE PROVIDES CODE FOR WDM CROSS REF

WDM DIA CROSS REF

CODE	WIRING DIAGRAM	SH
1	73 37 01	1

EM1-0002-73-107

R
R

Fuel Temperature System Electrical Circuits
SCHEM 1

EFFECTIVITY: ALL

0018

FUEL TEMPERATURE SYSTEM - ADJUSTMENT AND TEST

1. Referenced Procedure

   24-41-00 External Power/Ground Service System - Maintenance Practices

2. Adjustment/Test

   A. Fuel Temperature System Operational Test

      (1) Turn on electrical power (Ref. 24-41-00).

      (2) On Flight Engineer/Second Officer aft circuit breaker panel CB3, zone 215, verify that circuit breaker FUEL TEMP is closed.

      (3) On Flight Engineer/Second Officers FUEL SYSTEM panel, zone 215, located fuel TEMP indicator and FUEL TEMP rotary switch.

      (4) Place rotary switch in TANK position.

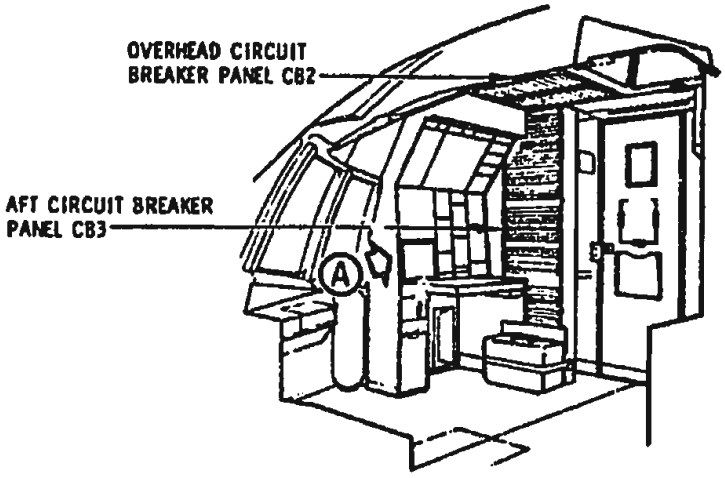
      (5) Verify that TEMP indicator reads approximately ambient temperature.

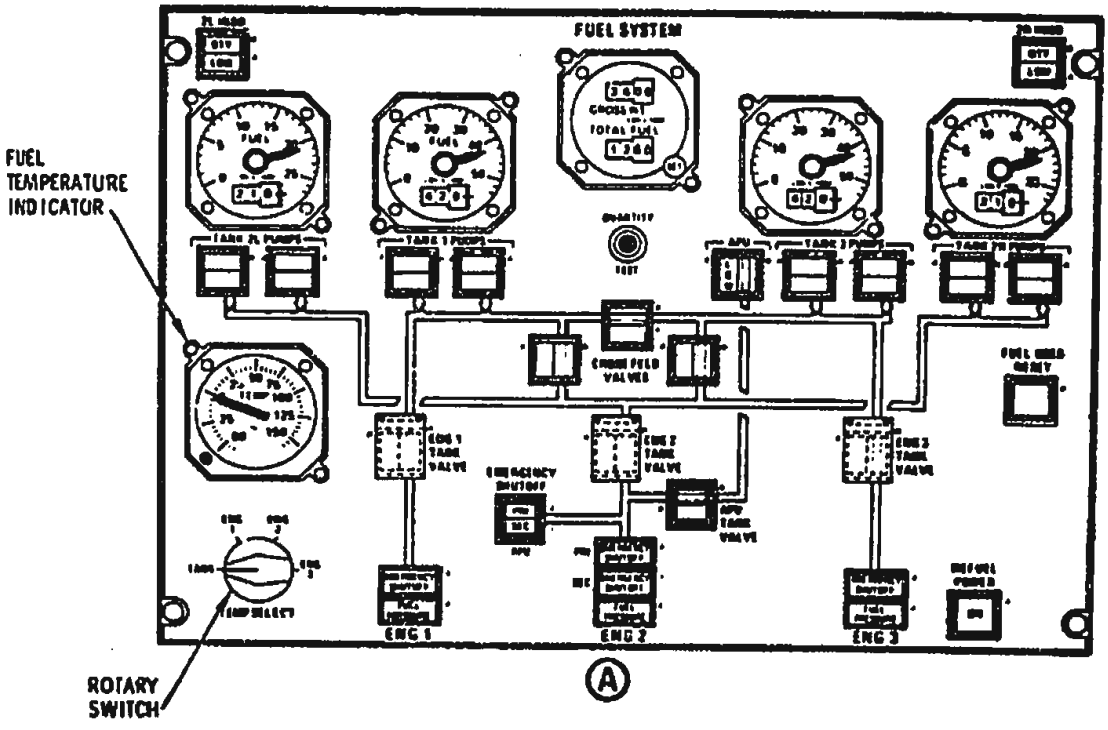
      (6) Place rotary switch, in sequence, in ENG 1, ENG 2, and ENG 3 position, and verify that fuel temperature indication in each position is approximately ambient.

      NOTE: Engines that have been run recently will have a higher fuel temperature indication.

      (7) Place the rotary switch in TANK position.

      (8) Turn off electrical power (Ref. 24-41-00).





MA 0720
MI-0100-73-501

Fuel Temperature Indication - Adjustment and Test
Figure 501

FUEL TEMPERATURE BULB - REMOVAL AND INSTALLATION

1. Equipment and Materials

Protective caps and plugs

Container (minimum capacity: 5 U.S. gallons, 4 Imperial gallons, or 18 liters)

Flexible hose: approximate length of 72 in. (1800 mm) and ID of 0.5 in. (12 mm)

Lock-wire, Fed Spec QQ-W-390, 0.032-inch diameter, or equivalent

2. Referenced Procedures

71-11-00	LH Hinged Cowl - Servicing
71-12-01	LH and RH Lower Hinged Cowl - Servicing
73-00-00	Engine Fuel and Control - Servicing
73-00-00	Engine Fuel and Control - Adjustment and Test
73-11-01	Low-pressure Fuel Pump - Maintenance Practices
73-37-00	Fuel Temperature System - Adjustment and Test

3. Removal/Installation

A. Removal

(1) On Flight Engineer/Second Officers FUEL SYSTEM panel, zone 215, release (out) the applicable ENG TANK VALVE switchlight.

(2) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag circuit breaker FUEL TEMP (R13).

(3) Open applicable LH hinged cowl, 413A or 423A for engine No. 1 or 3 (Ref. 71-11-00) or 433DL for engine No. 2 (Ref. 71-12-01).

(4) Drain low-pressure fuel filter (Ref. 73-11-01).

R CAUTION: ENSURE ELECTRICAL CONNECTOR IS FREE FROM LIQUID AND/OR SOLID CONTAMINATION BEFORE DISCONNECTING.

(5) Disconnect the temperature bulb electrical connector (Ref. Fig. 401).

(6) Remove temperature bulb and gasket.

(7) Install protective caps and plugs on exposed openings and electrical connector.

B. Installation

(1) Verify that circuit breaker opened in Step 3A(2) is open and tagged.

(2) Remove protective caps and plugs from openings and electrical connector.

(3) Install a new gasket on temperature bulb (Ref. Fig. 401).

(4) Install and secure temperature bulb in aperture in fuel filter and lock-wire.

R CAUTION: ENSURE ELECTRICAL CONNECTOR IS FREE FROM LIQUID AND/OR SOLID CONTAMINATION BEFORE CONNECTING.

(5) Connect and secure electrical connector (Ref. Fig. 401).

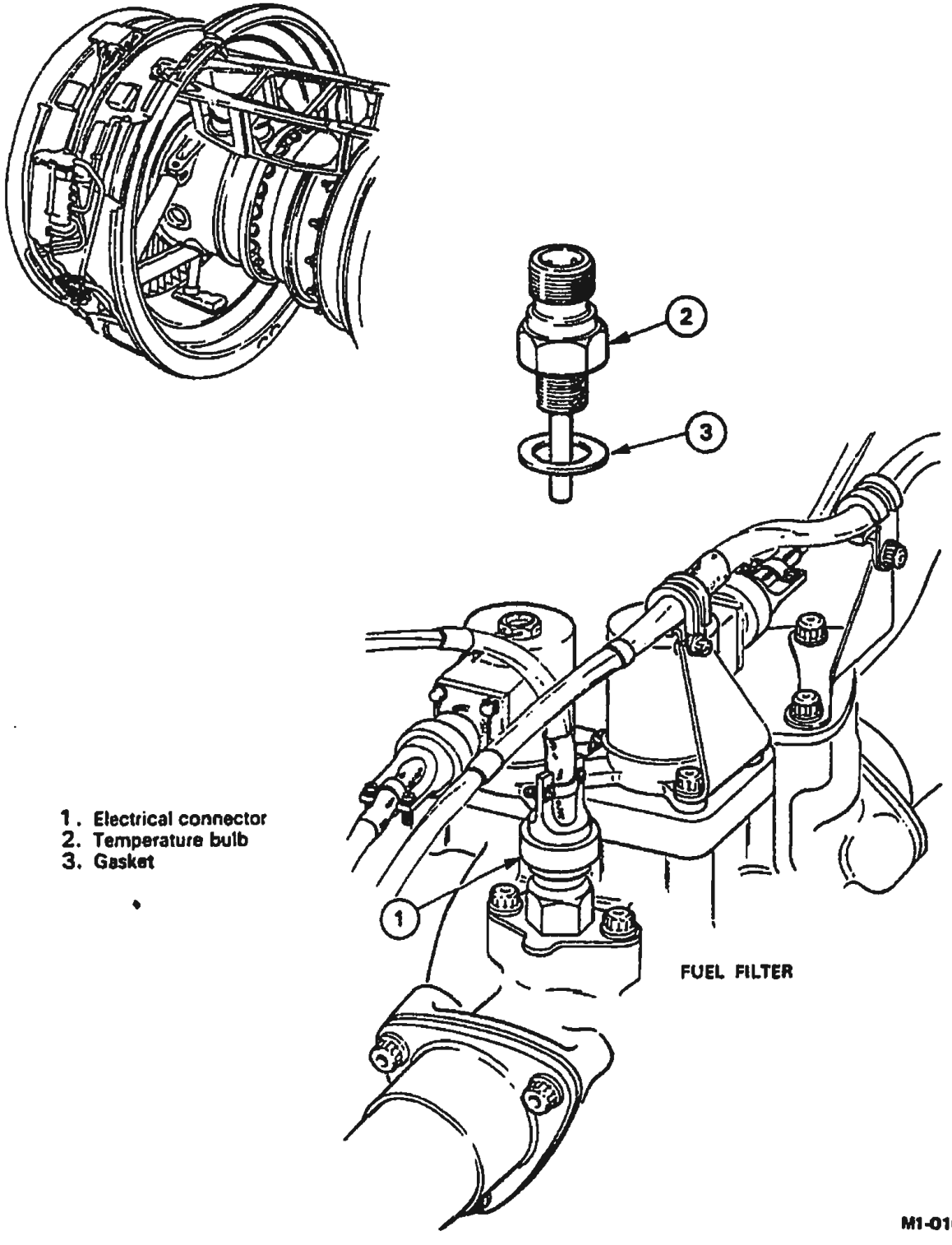
(6) Prime low-pressure fuel system (Ref. 73-00-00, Servicing).

(7) Remove tag and close circuit breaker opened in Step 3A(2).

(8) Test engine fuel temperature indicating system operation (Ref. 73-37-00).

(9) Test for leaks at disconnect points (Ref. 73-00-00, Adjustment and Test).

(10) Close applicable LH hinged cowl.



1. Electrical connector
2. Temperature bulb
3. Gasket

HH 9801
M1-0100-73-403
25562

R Fuel Temperature Bulb - Removal and Installation
R Figure 401

EFFECTIVITY: ALL

001B

ENGINE FUEL TEMPERATURE INDICATOR - REMOVAL AND INSTALLATION

1. Equipment and Materials

   Protective caps

2. Referenced Procedure

   73-37-00 Fuel Temperature System - Adjustment and Test

3. Removal/Installation

   A. Removal

      (1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag circuit breaker FUEL TEMP.

      On Flight Engineer/Second Officers overhead circuit breaker panel CB2, zone 215, open and tag circuit breaker F/E INSTR.

      (2) On Flight Engineer/Second Officers FUEL SYSTEM panel, zone 210, locate engine fuel TEMP indicator (Ref. Fig. 401).

      (3) Loosen clamp screw that secures the indicator in the panel.

      (4) Withdraw indicator and disconnect electrical connector. Cap and stow connector.

   B. Installation

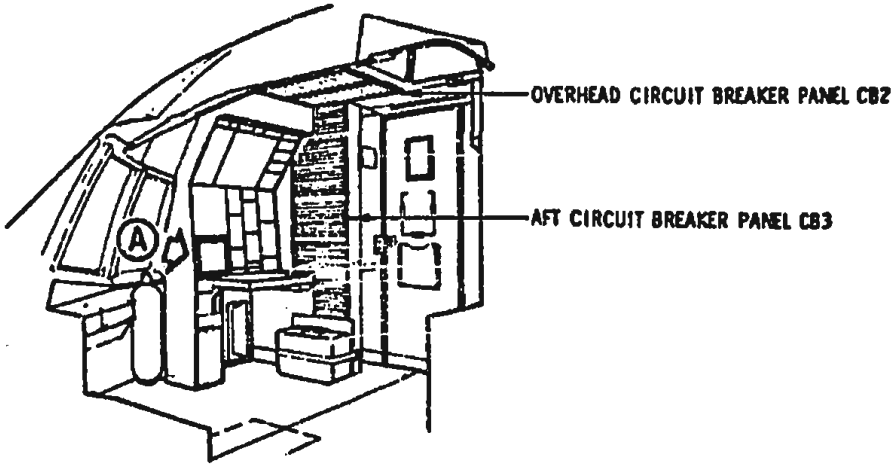
      (1) Verify that circuit breakers opened in Step 3A(1) are open and tagged.

      (2) Remove protective cap and connect indicator electrical connector to harness connector.

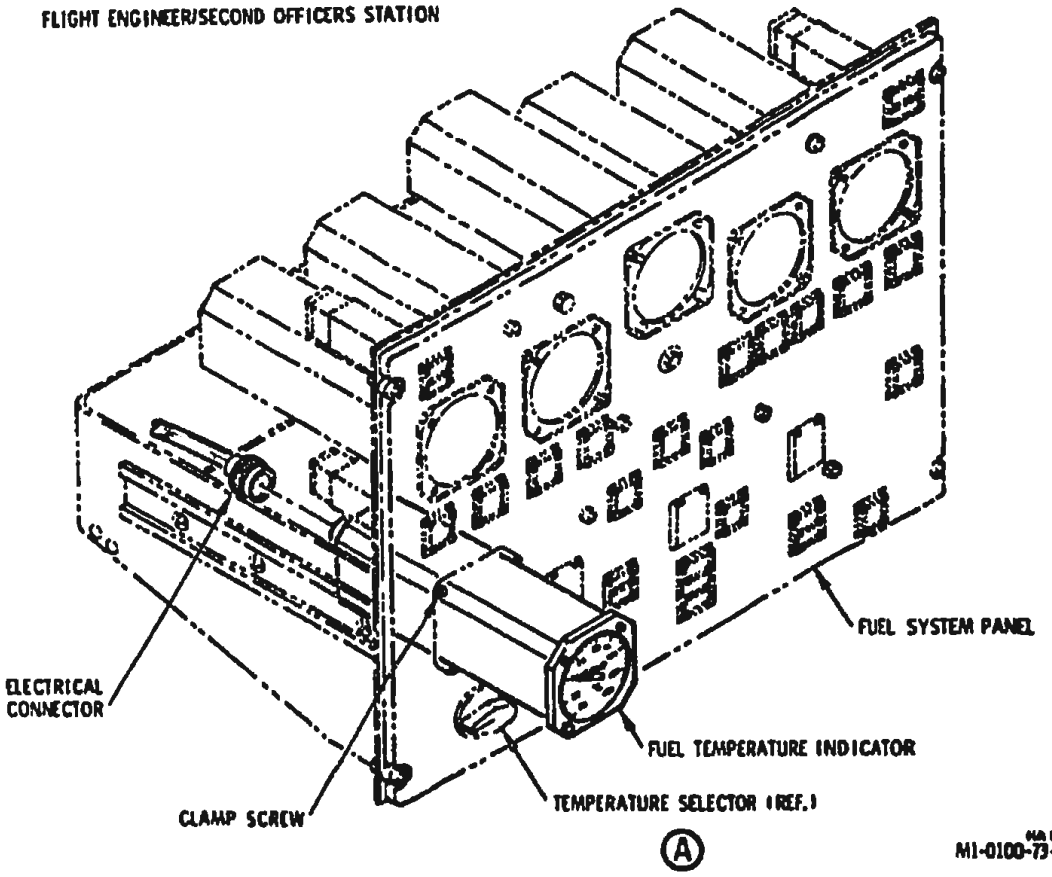
      (3) Slide indicator into panel cutout until bezel is positioned against panel.

      (4) Secure indicator by tightening clamp screws. Torque clamp screws 5 to 8 lb in.

      (5) Remove tags and close circuit breakers opened in Step 3A(1)



FLIGHT ENGINEER/SECOND OFFICERS STATION



Engine Fuel Temperature Indicator - Removal and Installation
Figure 401

(6) Perform system test (Ref. 73-37-00).

WING TANK FUEL TEMPERATURE SENSOR - REMOVAL AND INSTALLATION

1. Referenced Procedures

20-24-02	Crimped Electrical Contact - Removal and Installation
24-41-00	External Power/Ground Service System - Maintenance Practices
73-37-00	Fuel Temperature System - Adjustment and Test

2. Removal/Installation

A. Removal

(1) On Flight Engineer/Second Officers aft circuit breaker panel CB3, zone 215, open and tag circuit breaker INSTR & CONTROLS ALL ENGINE - FUEL TEMP.

(2) Open access panel 541GB on bottom of left wing.

(3) Depress lock and rotate counterclockwise to disengage lock from well and flange assembly (Ref. Fig. 401). Remove fuel temperature sensor (resistance bulb) from well and flange assembly.

(4) Disconnect and tag wires on adjacent terminal junction modules (Ref. 20-24-02).

(5) Remove sensor.

B. Installation

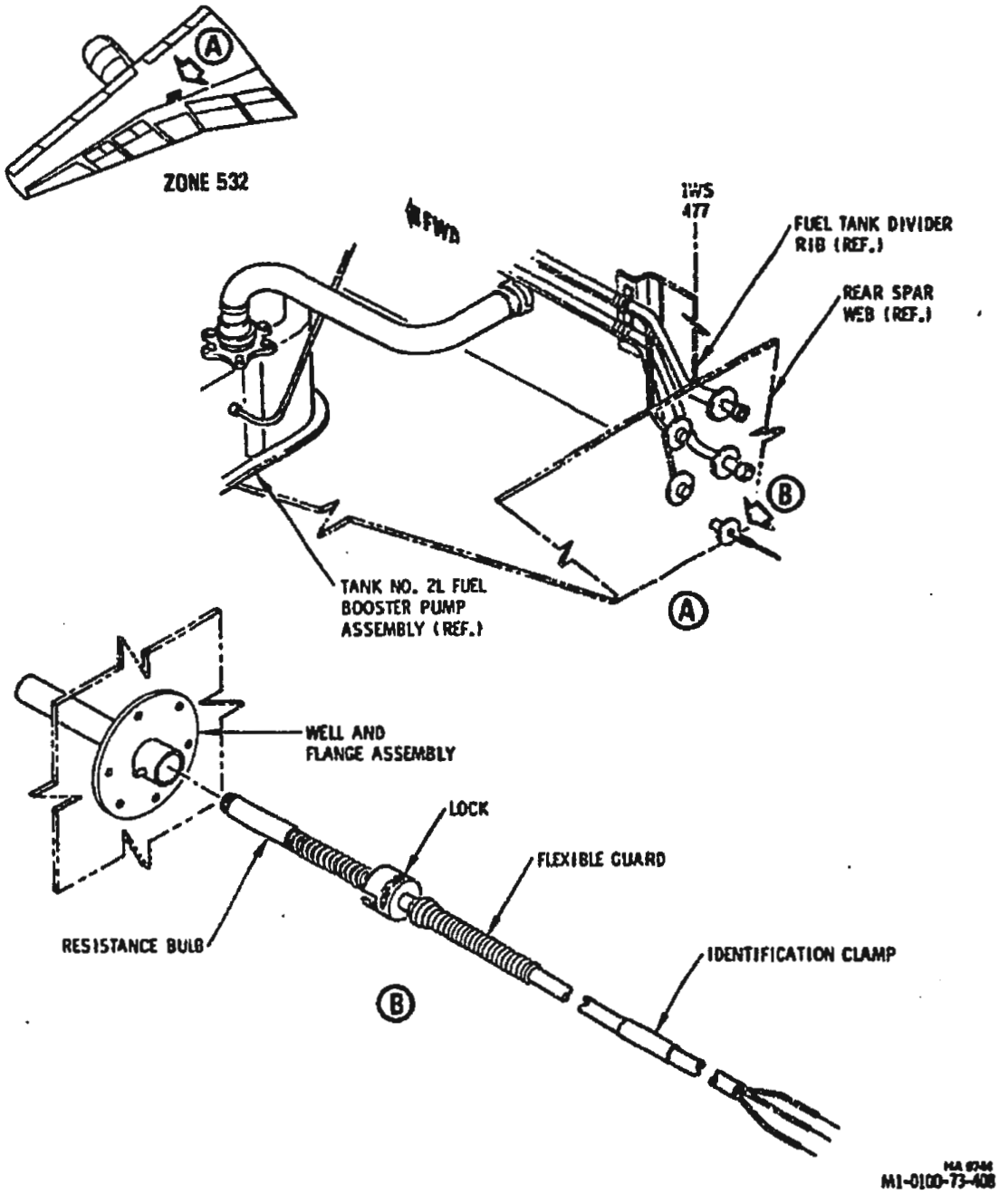
(1) Verify that circuit breaker opened in Step 2A(1) is open and tagged.

(2) Install fuel temperature sensor pins in terminal junction modules in accordance with tagged wires (Ref. 20-24-02).

(3) Install fuel temperature sensor in well and flange assembly. Rotate lock clockwise to secure fuel temperature sensor in well and flange assembly.

(4) Remove tag and close circuit breaker opened in Step 2A(1).

(5) Turn on electrical power (Ref. 24-41-00).



Wing Tank Fuel Temperature Sensor - Removal and Installation
Figure 401

(6) On FUEL SYSTEM panel, zone 215, place FUEL SYSTEM TEMP SELECT switch in TANK position. Check that fuel system temperature indicator on FUEL SYSTEM panel indicates a temperature.

(7) Perform system test (Ref. 73-37-00).

(8) Turn off electrical power (Ref. 24-41-00).

(9) Close access panel.

R # AIDS FUEL INDICATING - DESCRIPTION AND OPERATION

R 1. General

R The differential pressure across the fuel flow regulator and the R angular position of the air throttle lever (Ref. 73-21-00) are R sensed by transducers that provide electrical signals for input R to the aircraft integrated data system (AIDS).

R The engine mounted units of the system consists of two R transducers located in zones 412, 422, and 432. The R high-pressure fuel differential pressure transducer (Ref. Fig. R 1) is mounted on the front face of the engine firewall at the R lower left-hand position.

R On Engines with SB77-4406, R the transducer support bracket is mounted on anti-vibration R bushes. The throttle position transducer (Ref. Fig. 2) is R mounted on a bracket attached to the high-speed external gearbox R input drive housing.

R 2. Operation

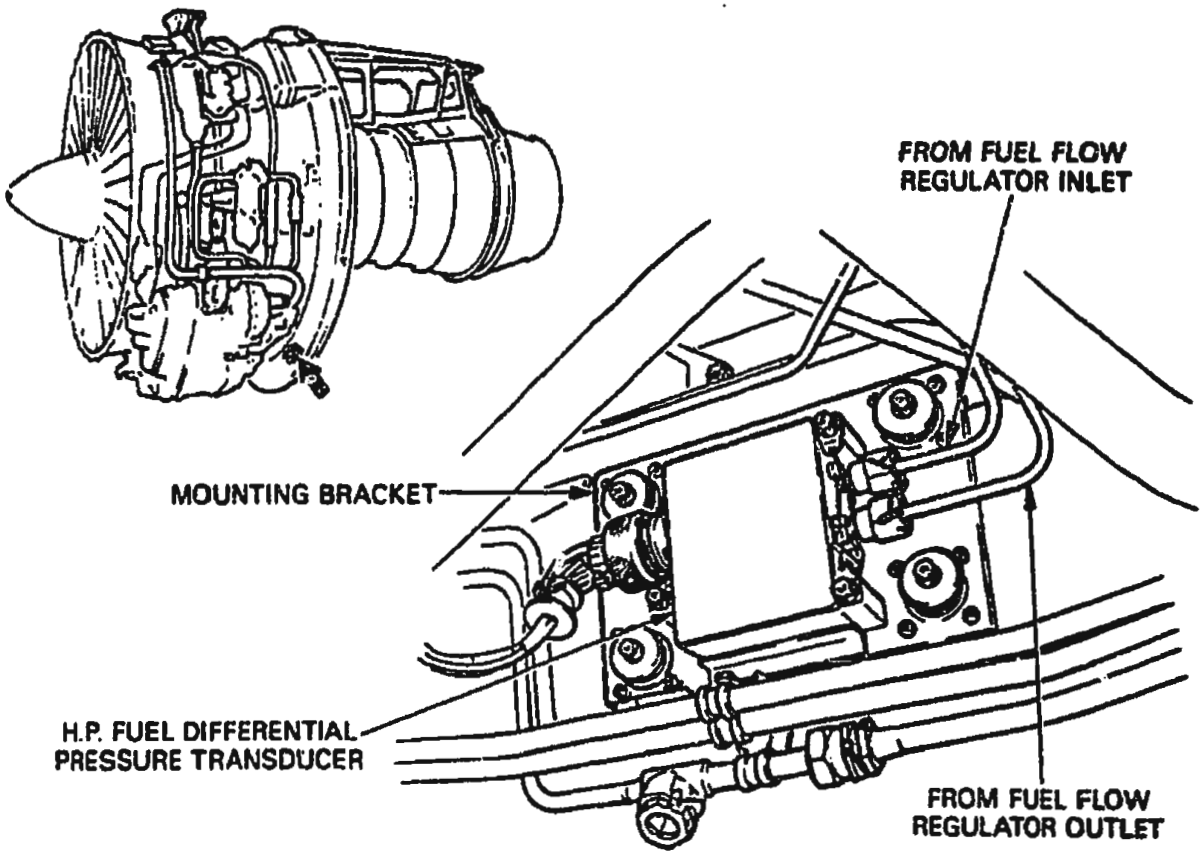
R Fuel flow regulator inlet and outlet fuel pressures are tapped R from two connectors on the regulator and are routed through R rigid tubes to connectors on the differential pressure R transducer. Within the transducer the fuel pressures act each R side of a diaphragm, deflection of which results in a dc voltage R output from the transducer.

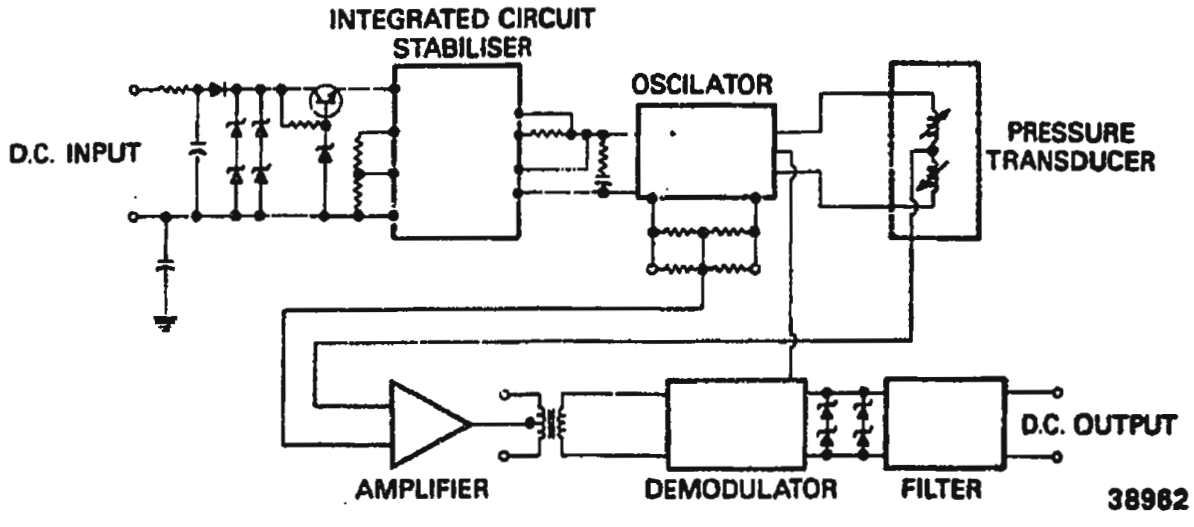
R The angular position of the air throttle lever is transmitted to R the position transducer by a hose connected between the fuel R flow regulator control box output shaft and the transducer input R shaft. Input shaft rotation displaces a synchro rotor within R the transducer, which varies the output voltage of each of three R stator windings as a direct function of air throttle lever R position.

R The dc output from the differential pressure transducer and the R three ac outputs from the position transducer are connected R through the engine electrical harness and the aircraft R electrical system to a data acquisition unit (Ref. 31-32-00).

R 3. High-pressure Fuel Differential Pressure Transducer

R A. Description and Operation





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R High-pressure Fuel Differential Pressure Transducer
R and Circuit Diagram
R Figure 1

R EFFECTIVITY: ALL
R
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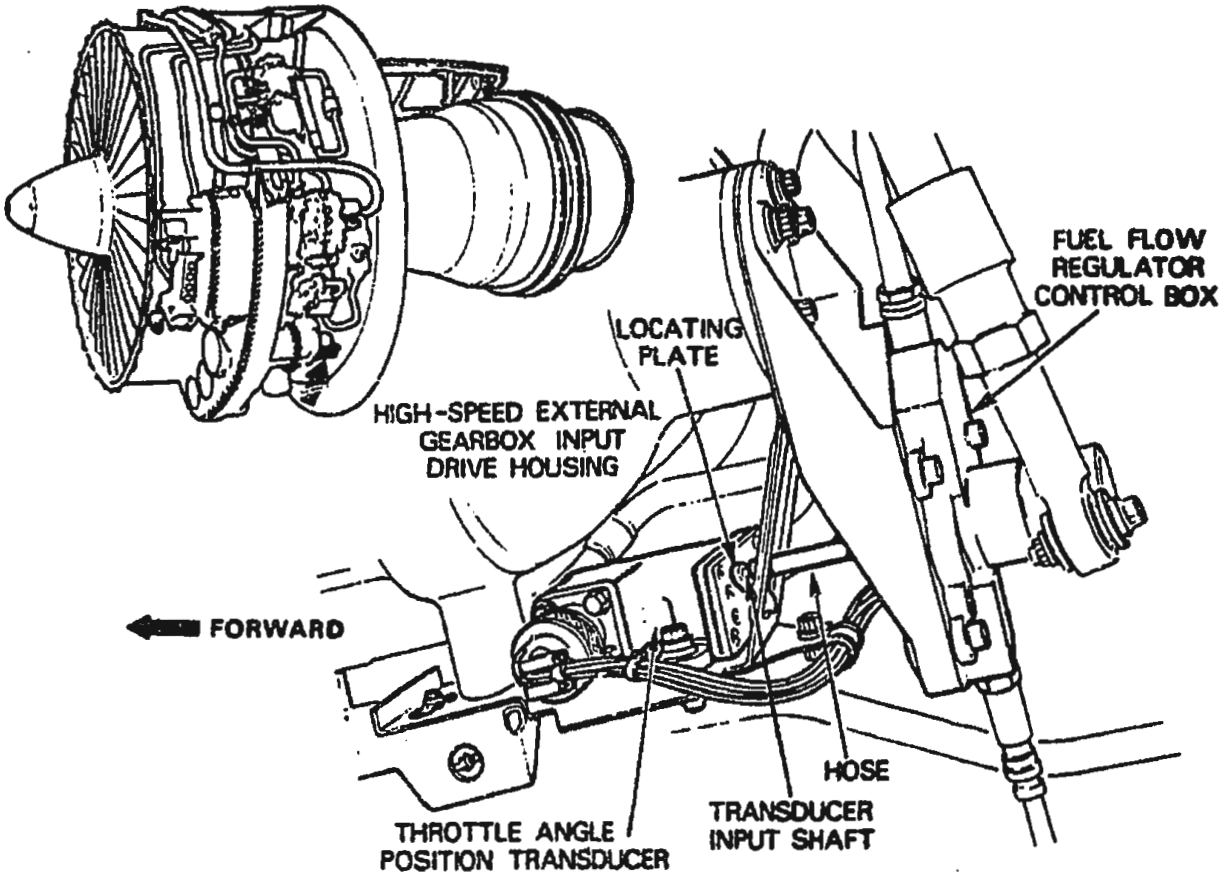

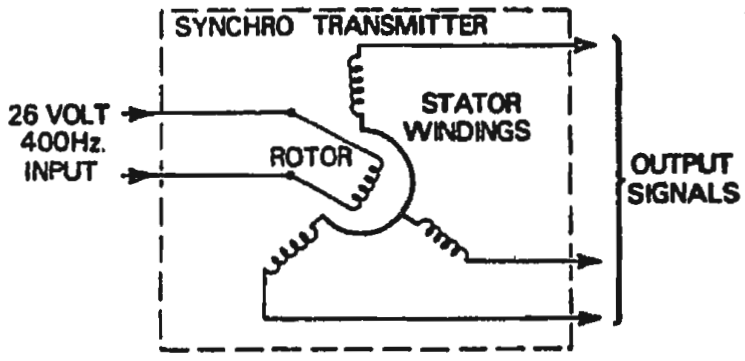

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R Throttle Angle Position Transducer
R Figure 2

R EFFECTIVITY: ALL
R
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R The high-pressure fuel differential pressure transducer
R (Ref. Fig. 1) is fitted on the front face of the engine
R firewall at the lower left-hand position, zones 412, 422 and
R 432.

R The transducer basically comprises a case which incorporates
R two pressure connectors and an electrical receptacle.
R Housed within the case are a variable reluctance pressure
R transducer and an electronic assembly.

R The variable reluctance pressure transducer basically
R comprises a metal diaphragm centrally disposed between two
R matched coils that are moulded into the core of a high
R permeability pot. The diaphragm and pot are encased between
R two end pieces incorporating drillings that direct fuel
R entering the pressure connectors to the appropriate side of
R the diaphragm.

R The electronic assembly basically comprises a stabilizer,
R oscillator, amplifier, demodulator and a filter.

R The transducer receives a 28 volt dc supply from the
R aircraft electrical system. This supply is passed through
R the integrated circuit stabilizer to the oscillator. The
R oscillator converts the dc supply to ac and energizes the
R variable reluctance pressure transducer which forms part of
R a balanced bridge circuit. In the balanced state there is
R no output from the bridge circuit.

R With the engine running, diaphragm deflection, due to the
R fuel pressures acting across it, varies the reluctance of
R the two matched coils causing the bridge to unbalance. The
R resultant output, the phase and value of which is directly
R related to the fuel pressure differential across the fuel
R flow regulator, is fed to the amplifier and then to the
R demodulator where it is converted to a dc voltage. This
R voltage is then passed through the filter and fed through
R external wiring to the data acquisition unit.

R 4. Throttle Angle Position Transducer

R A. Description and Operation

R The throttle angle position transducer (Ref. Fig. 2) is
R fitted on a bracket attached to the high-speed external
R gearbox input drive housing, zones 412, 422 and 432.

R The transducer comprises a case assembly which incorporates
R an electrical connector, an input shaft, a step-up gearbox
R and a synchro transmitter.

R The synchro transmitter consists of a rotor assembly and
R three sets of stator windings.

R A locating plate attached to the transducer input shaft is
R used, in conjunction with a hole drilled in the transducer
R plate, to enable the rotor to be rigged in the correct
R angular position, relative to the engine controls, during
R unit installation.

R The rotor windings are excited by a 26V 400Hz electrical
R supply from the data acquisition unit. Movement of the
R throttle control lever causes the input shaft to rotate.
R The shaft rotation is stepped-up through the gearbox and
R displaces the synchro rotor relative to the stator windings.
R This causes the voltages induced in the three stator
R windings to alter and produce signals relative to the air
R throttle lever position. The three ac outputs are then fed
R through external wiring to the data acqusition unit.

R HP FUEL DIFFERENTIAL PRESSURE TRANSDUCER
R REMOVAL AND INSTALLATION

R 1. Equipment and Materials

R Container (minimum capacity: 2.5 U.S. gallons, 2 Imperial
R gallons, or 9 liters)

R Lock-wire, Fed Spec QQ-W-390, 0.032-inch diameter, or equivalent

R Protective caps

R 2. Referenced Procedures

R	24-41-00	Electrical Power/Ground Service System - Maintenance Practices
R	70-51-00	Torque Tightening Technique - Maintenance Practices
R	71-11-00	LH Hinged Cowl - Servicing
R	71-12-01	LH and RH Lower Hinged Cowl - Servicing

R 3. Removal/Installation

R A. Removal

R (1) Close applicable engine fuel firewall shutoff valve as
R follows:

R (a) Turn on electrical power (Ref. 24-41-00).

R (b) On pilots overhead panel, zone 210, pull
R applicable FIRE PULL handle.

R (c) Turn off electrical power.

R (2) On Flight Engineer/Second Officers aft circuit breaker
R panel CB3, zone 215, open and tag circuit breakers
R AIDS/FLT RCDR - DC (H10), Aϕ (H11), Bϕ (H12), and Cϕ
R (H13).

R (3) Open applicable LH hinged cowl: 413A or 423A for
R engine No. 1 or No. 3 (Ref. 71-11-00), or 433AL for
R engine No. 2 (Ref. 71-12-01).

R CAUTION: ENSURE ELECTRICAL CONNECTION IS FREE FROM LIQUID
R AND/OR SOLID CONTAMINATION BEFORE CONNECTING.

R (4) Disconnect the high-pressure fuel differential pressure
R transducer electrical connector (Ref. Fig. 401).

R (5) Place a container under the transducer.

R (6) Disconnect the fuel flow regulator inlet and outlet
R reference lines from the transducer. Allow the lines
R to drain into the container and attach identification
R tags for installation.

R (7) Remove bolts, lug, and washers and remove transducer
R from mounting bracket.

R (8) Install protective caps on all exposed connectors and
R openings.

R B. Installation

R (1) Verify the following:

R (a) FIRE PULL handle pulled in Step 3A(1) is pulled
R and tagged.

R (b) Circuit breaker opened in Step 3A(2) is open and
R tagged.

R (2) Remove protective caps from all connectors and
R openings.

R (3) Mount transducer (Ref. Fig. 401) on bracket, ensuring
R positive location of detent with mounting bracket
R dowel.

R (4) Install transducer on mounting bracket with bolts,
R washers, and lug.

R (5) Connect and tighten fuel flow regulator inlet and
R outlet reference lines, and remove identification tags.

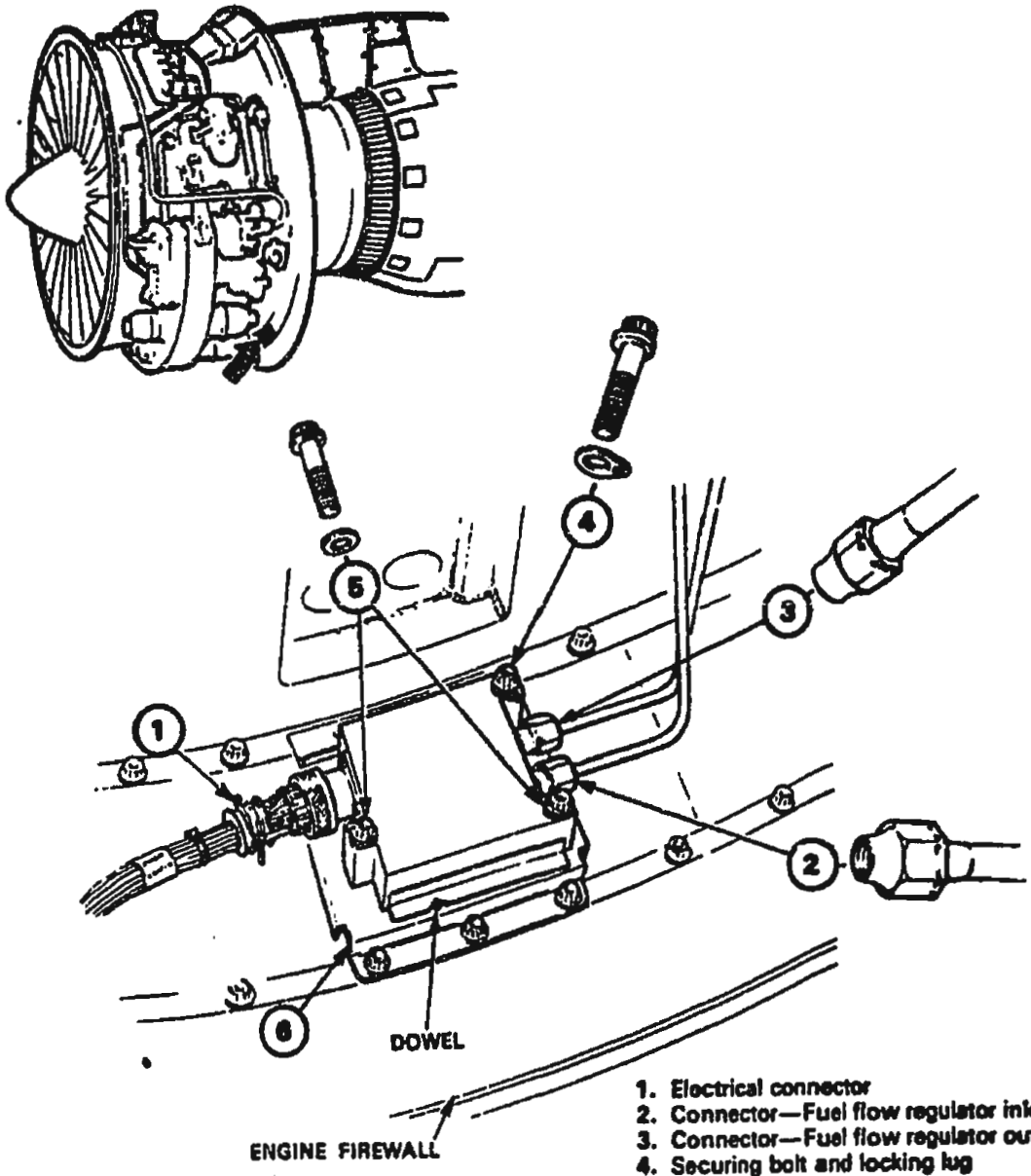
R (6) Lock-wire reference lines to locking lug.

R CAUTION: ENSURE ELECTRICAL CONNECTOR IS FREE FROM LIQUID
R AND/OR SOLID CONTAMINATION BEFORE DISCONNECTING.

R (7) Connect and secure the transducer electrical connector.

R (8) Remove tag and close circuit breaker opened in Step
R 3A(2) then close applicable FIRE PULL handle as
R follows:

R (a) Turn on electrical power (Ref. 24-41-00).



1. Electrical connector
2. Connector—Fuel flow regulator inlet pressure
3. Connector—Fuel flow regulator outlet pressure
4. Securing bolt and locking lug
5. Securing bolt and washer(2 off)
6. Mounting bracket

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M1-5000-73-404

R HP Fuel Differential Pressure Transducer Disconnect Points
R Figure 401

R EFFECTIVITY: ALL
R
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R (b) On pilots overhead panel, zone 210, push in
R applicable FIRE PULL handle.

R (c) Turn off electrical power.

R (9) Close LH hinged cowl.

R THROTTLE ANGLE POSITION TRANSDUCER - REMOVAL AND INSTALLATION

R 1. Equipment and Materials

R Pliers, Rolls-Royce Ltd. PN UT.88, or equivalent

R Rigging Pin, Rolls-Royce Ltd., PN 3502230, or equivalent

R Rigging Pin, Rolls-Royce Ltd., PN UT.993, or equivalent

R Protective cap

R 2. Referenced Procedures

R 71-11-00 Engines No. 1 and No. 3 Cowling - Servicing

R 71-12-01 LH and RH Lower Hinged Cowl - Servicing

R 76-11-00 Engine Control System - Adjustment and Test

R 3. Service Bulletins

R RR SB76-4312 - Introduction of stiffer mounting bracket for HP 3
R bleed valve solenoid and AIDS throttle transducer.

R 4. Removal/Installation (Engines Without RR SB76-4312)

R A. Removal

R (1) On Flight Engineer/Second Officers aft circuit breaker
R panel CB3, zone 215, open and tag circuit breakers
R AIDS/FLT RCDR - DC (H10), Aϕ (H11), Bϕ (H12), and Cϕ
R (H13).

R (2) Open applicable LH hinged cowl: 413A or 423A for
R engine No. 1 or No. 3 (Ref. 71-11-00), or 433AL for
R engine No. 2 (Ref. 71-12-01).

R CAUTION: ENSURE ELECTRICAL CONNECTOR IS FREE FROM LIQUID
R AND/OR SOLID CONTAMINATION BEFORE DISCONNECTING.

R (3) Disconnect throttle angle transducer electrical
R connector (Ref. Fig. 401).

R (4) Remove securing clips.

R (5) Remove securing bolts, washers, and nuts. Leave AIDS
R harness support bracket attached to harness.

R (6) Remove transducer from support bracket.

R (7) Remove and discard crimping clip and hose.

R (8) Install protective cap on electrical connector.

R B. Installation

R (1) Verify that circuit breakers opened in Step 4A(1) are
R open and tagged.

R (2) Install new hose to transducer spindle (Ref. Fig. 401)
R as follows:

R (a) Install crimping clip over hose then secure hose
R to spindle with clip, using pliers, in dimensional
R position shown in view A.

R (b) Install securing clip over hose; do not tighten at
R this stage.

R (3) Place transducer on support bracket installing free end
R of hose over fuel flow regulator control box spindle.

R (4) Secure transducer with bolts, washers and nuts placing
R AIDS harness support bracket under rear nuts. Trim off
R excess hose to dimensions shown in view A, Fig. 401.

R (5) Rotate hose to align slot in rotating plate attached to
R transducer spindle with rigging hole in transducer
R body, then insert rigging pin 3502230.

R (6) Set throttle controls in rigging position (Ref.
R 76-11-00) then insert rigging pin UT.993 in control box
R rigging hole.

R (7) Place securing clip dimensionally as shown in view A,
R Fig. 401, then tighten to secure hose to control box
R spindle.

R (8) Remove both rigging pins from rigging holes.

R CAUTION: ENSURE ELECTRICAL CONNECTOR IS FREE FROM LIQUID
R AND/OR SOLID CONTAMINATION BEFORE CONNECTING.

R (9) Remove protective cap, then connect and secure
R electrical connector (Ref. Fig. 401).

R (10) Remove tags and close circuit breakers opened in Step
R 4A(1).

R (11) Close LH hinged cowl.

R 5. Removal/Installation (Engines With RR SB76-4312)

R A. Removal

R (1) On Flight Engineer/Second Officers aft circuit breaker
R panel CB3, zone 215, open and tag circuit breakers
R AIDS/FLT RCDR-DC (H10) AO (H11), BO (H12), and CO
R (H13).

R (2) Open applicable L. H. hinged cowl: 413A or 423A for
R engine No. 1 or No. 3 (Ref. 71-11-00), or 433 AL for
R engine No. 2 (Ref. 71-12-01).

R CAUTION: ENSURE ELECTRICAL CONNECTOR IS FREE FROM LIQUID
R AND/OR SOLID CONTAMINATION BEFORE DISCONNECTING.

R (3) Disconnect throttle angle transducer electrical
R connector [Ref. Fig. 401 (Sheet 1)].

R (4) Remove harness securing clip.

R (5) Remove securing bolts and support bracket.

R (6) Remove securing clip [Ref. Fig. 401 (Sheet 2)].

R (7) Remove securing bolts, washers and nuts.

R (8) Remove transducer from support plate.

R (9) Remove and discard crimping clip and hose.

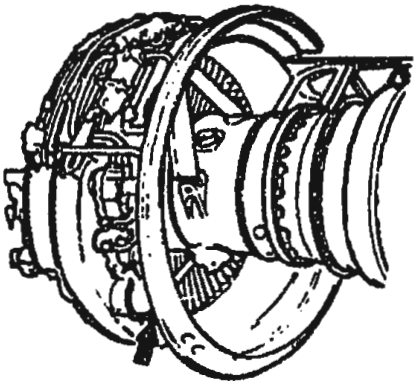
R (10) Install protective cap on electrical connector.

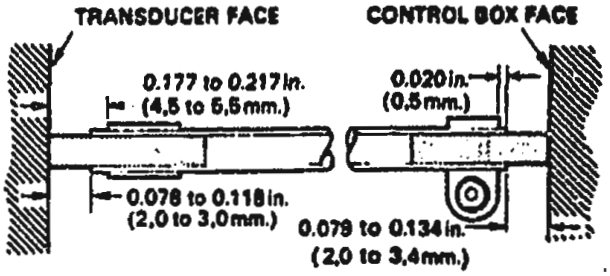
R B. Installation

R (1) Verify that circuit breakers opened in Step 5A(1) are
R open and tagged.

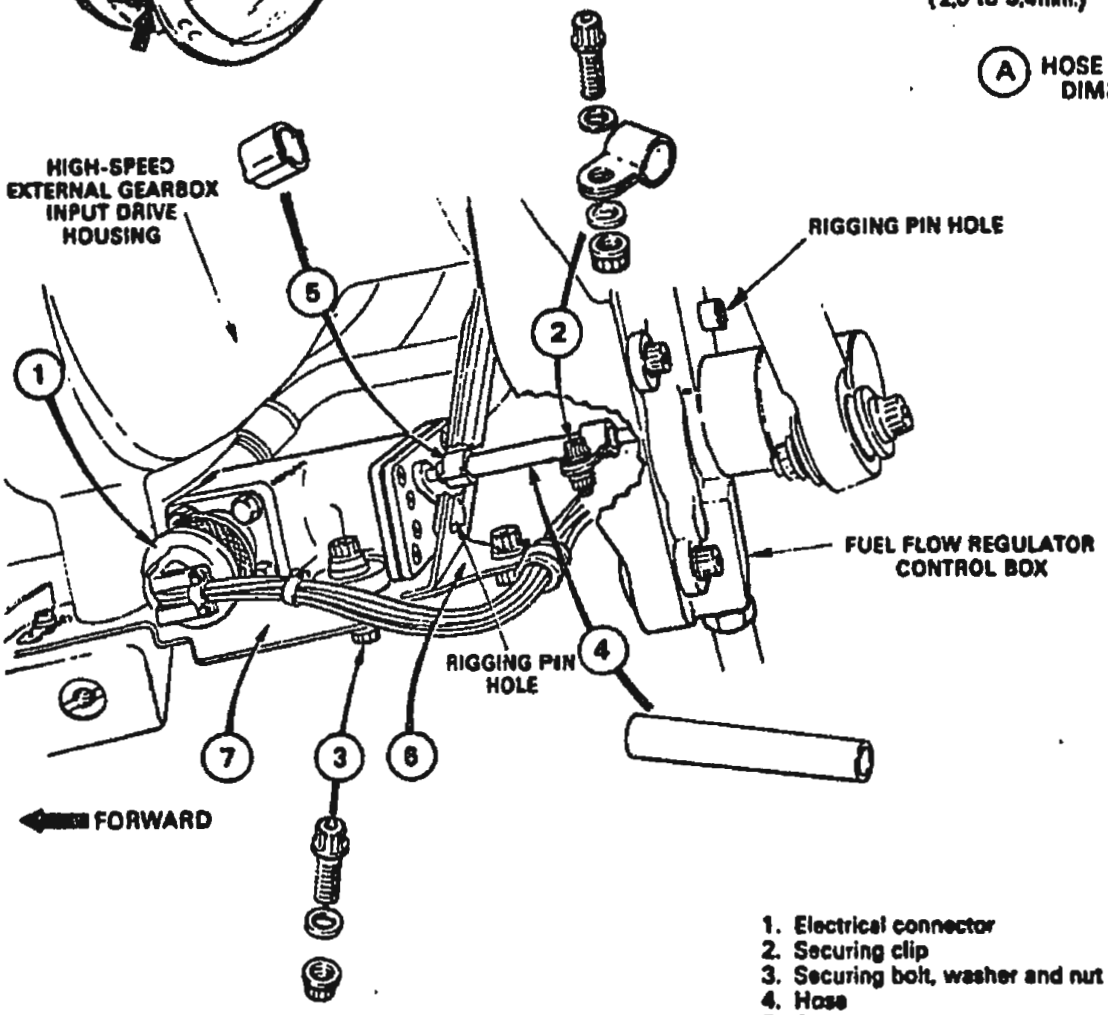
R (2) Install new hose to transducer spindle as follows [Ref.
R Fig. 401 (Sheet 2)]:

R (a) Install crimping clip over hose; then secure hose
R to spindle with clip, using pliers, in dimensional
R position shown in View A.





(A) HOSE POSITION DIMENSIONS



1. Electrical connector
2. Securing clip
3. Securing bolt, washer and nut (3 off)
4. Hose
5. Crimping clip
6. AIDS harness support bracket
7. Support bracket

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R Transducer Disconnect Points
R Figure 401

R EFFECTIVITY: ENGINES WITHOUT RR SB76-4312
R
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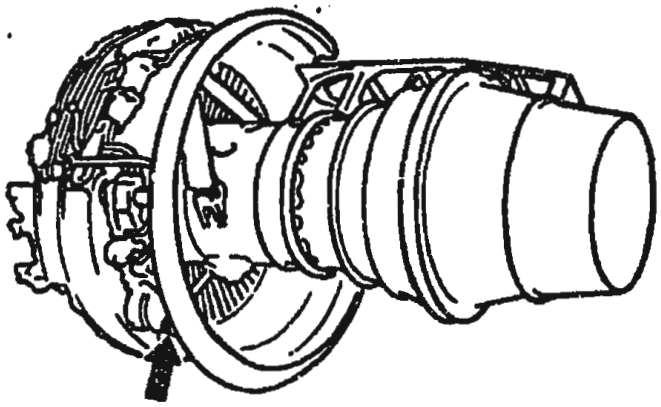
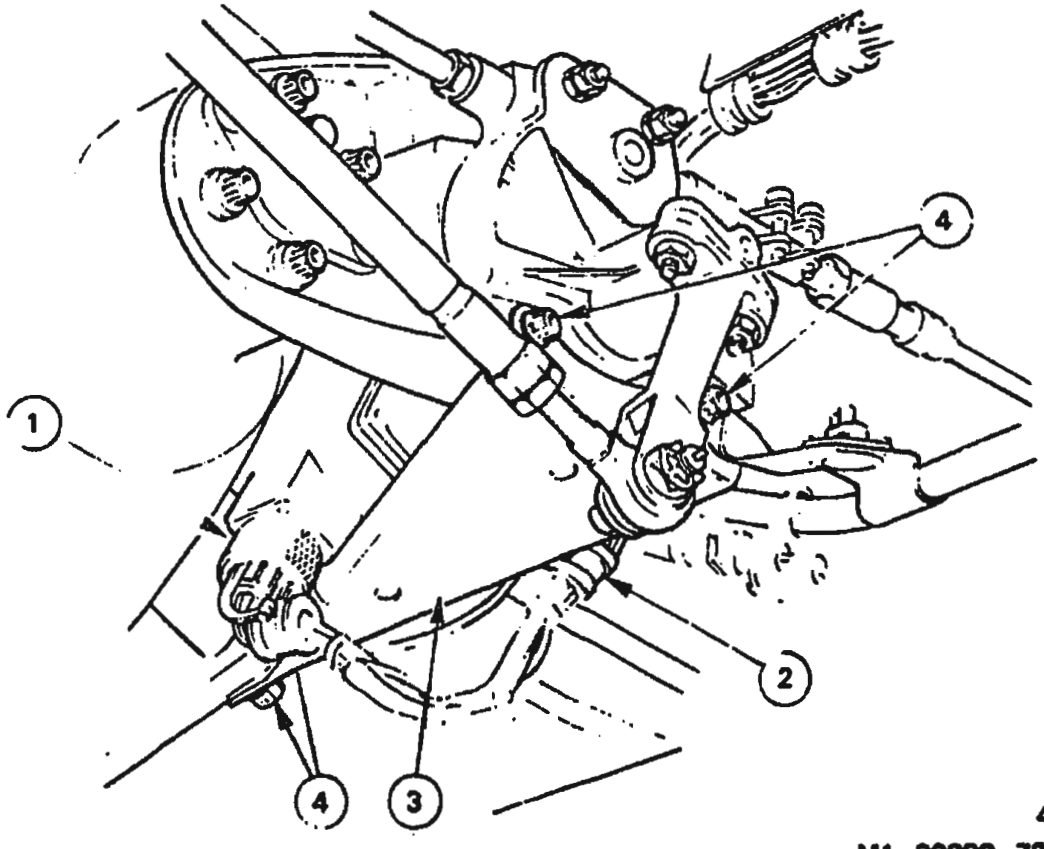


1. Electrical connector
2. Securing clip
3. Support bracket
4. Securing bolts(4off)



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R Transducer Disconnect Points
R Figure 401 (Sheet 1)

R EFFECTIVITY: ENGINES WITH RR SB76-4312
R
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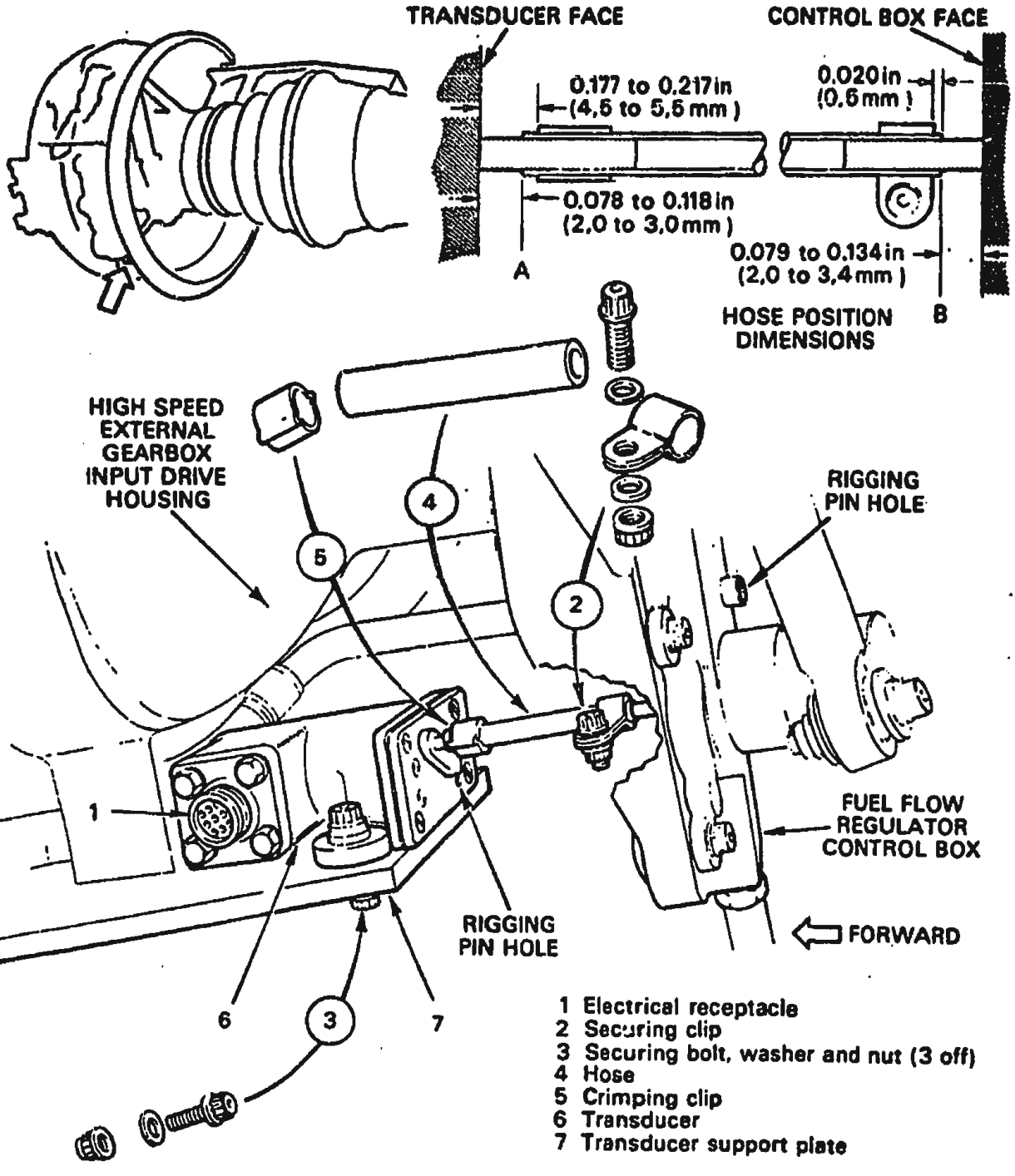

1 Electrical receptacle
2 Securing clip
3 Securing bolt, washer and nut (3 off)
4 Hose
5 Crimping clip
6 Transducer
7 Transducer support plate

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R Transducer Disconnect Points
R Figure 401 (Sheet 2)

R EFFECTIVITY: ENGINES WITH RR SB76-4312
R
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R (b) Install securing clip over hose; do not tighten at
R this stage.

R (3) Place transducer on support plate installing free end
R of hose over fuel flow regulator control box spindle.

R (4) Secure transducer with bolts, washers and nuts. Trim
R off excess hose to dimensions shown in View B [Ref.
R Fig. 401 (Sheet 2)].

R (5) Rotate hose to align slot in rotating plate attached to
R transducer spindle with rigging hole in transducer
R body; then insert Rigging Pin 3502230.

R (6) Set throttle controls in rigging position (Ref.
R 76+11+00); then insert Rigging Pin UT.993 in control
R box rigging hole.

R (7) Place securing clip dimensionally as shown in View B,
R Fig. 401 (Sheet 2) then tighten to secure hose to
R control box spindle.

R (8) Remove both rigging pins from rigging holes.

R (9) Fit support bracket and securing bolts [Ref. Fig. 401
R (Sheet 1)].

R (10) Position and secure harness clip.

R CAUTION: ENSURE ELECTRICAL CONNECTOR IS FREE FROM LIQUID
R AND/OR SOLID CONTAMINATION BEFORE CONNECTING.

R (11) Remove protective cap; then connect and secure
R electrical connector.

R (12) Remove tags and close circuit breakers opened in Step
R 5A(1).

R (13) Close L. H. hinged cowl.